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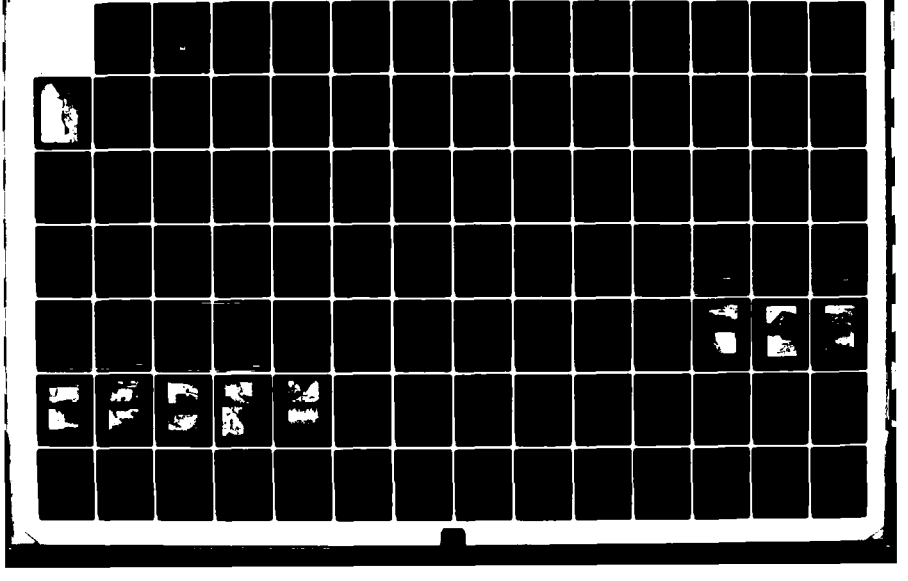

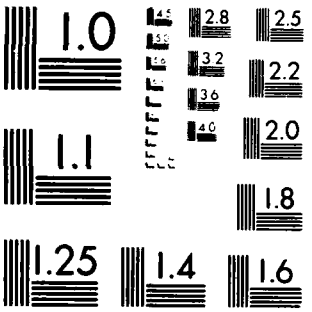

FARMINGTON RIVER BASIN

HARWINTON, CONNECTICUT

BRISTOL RESERVOIR NO.4 DAM
CT 00364

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1981

UNCLASSIFIED
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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Farmington River Basin
Harwinton, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Bristol Reservoir No.4 Dam is a storage reservoir for public water supply. The dam consists of an earth embankment structure with a maximum height of 40 feet, a top width of 8 feet, and a total length of 970 feet including a 29.7 foot long concrete overflow spillway. Based on the visual inspection, the dam is judged to be in fair condition. The dam is classified as "Intermediate" in size with a "Significant" hazard potential. A test flood equal to ½ the PMF was selected.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

JUL 28 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Bristol Reservoir No. 4 Dam (CT-00364) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Protection, and to the owner, Bristol Water Department, Bristol, CT. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Protection for your cooperation in this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

BRISTOL RESERVOIR NO. 4 DAM
CT 00364

FARMINGTON RIVER BASIN
HARWINTON, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

49-045

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

IDENTIFICATION NO: CT 00364

NAME OF DAM: Bristol Reservoir No. 4 Dam

TOWN: Harwinton

COUNTY AND STATE: Litchfield County, Connecticut

STREAM: Poland River

DATE OF INSPECTION: April 28, 1981

BRIEF ASSESSMENT

Bristol Reservoir No. 4 Dam is a storage reservoir for public water supply owned by the Bristol Water Department. The dam consists of an earth embankment structure with a maximum height of 40 feet, a top width of 8 feet, and a total length of 970 feet including a 29.7 foot long concrete overflow spillway. The outlet works consist of a 20-inch cast iron pipe through the dam with an upstream gatehouse.

Based on the visual inspection, the dam is judged to be in fair condition. Features that could affect the future integrity of the dam are the downstream seepage, trees growing adjacent to the downstream toe and in the auxiliary spillway channel, continued undermining of the spillway apron and continued deterioration of the outlet works endwall.

The dam is classified as "Intermediate" in size with a "Significant" hazard potential. A Test Flood equal to one-half the Probable Maximum Flood (1/2 PMF) was selected in accordance with the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams. The Test Flood inflow of 1,840 cfs results in a

routed outflow of 1,410 cfs that would overtop the dam by 0.2 feet.

The spillway capacity without flashboards in place is 760 cfs or 54 percent of the Test Flood routed outflow.

It is recommended that the owner retain the services of a qualified, registered engineer to investigate the downstream seepage and the undermining of the spillway apron and to perform a detailed hydraulic and hydrologic analysis. In addition, flashboards should be removed from the spillway, trees should be removed from downstream of the dam and in the auxiliary spillway channel, the outlet works endwall should be repaired or replaced, a program of technical inspections should be instituted, an Operations and Maintenance Manual should be prepared, and a downstream warning system should be developed.

The owner should implement these recommendations as described herein and in greater detail in Section 7 of this report within one year of receipt of this Phase I Inspection Report.

Ronald G. Litke, P.E.
Project Engineer

Roald Haestad
President

This Phase I Inspection Report on Bristol Reservoir No.4 Dam (CT-00364) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechmical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the

condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety of the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

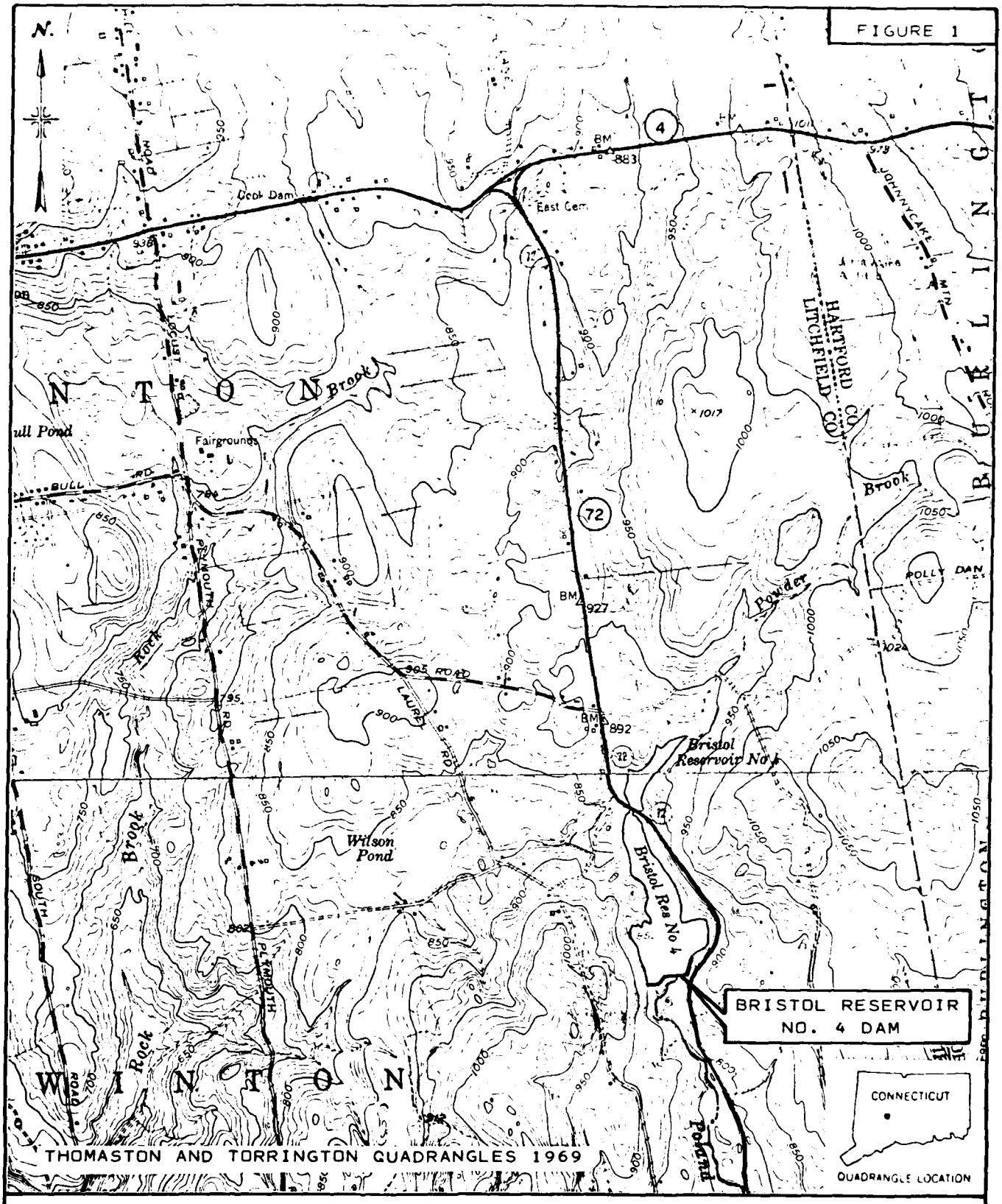
TABLE OF CONTENTS

INDEX TO REPORT

INDEX TO APPENDIXES

OVERVIEW PHOTO

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	BRISTOL RES. NO. 6 [illegible] POQUONOCK RIVER HARTFORD, CONNECTICUT
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		



LOCATION PLAN

BRISTOL RESERVOIR NO. 4 DAM
HARWINTON, CONNECTICUT

ROALD HAESTAD, INC.

SCALE: 1" = 2000'

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

BRISTOL RESERVOIR NO. 4 DAM

PROJECT INFORMATION

SECTION 1

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Roald Haestad, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Roald Haestad, Inc. under a letter of March 30, 1981, from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0048 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interest.
2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.
3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

The dam is located on the Poland River adjacent to Connecticut Route 72 approximately 2.5 miles south of the intersection of Route 72 with Connecticut Route 4, in the Town of Harwinton, Connecticut. The dam is shown on the Thomaston Quadrangle map having coordinates of latitude N41°-44.5' and longitude W73°-01.3'.

b. Description of Dam and Appurtenances

The dam consists of an earth embankment structure with a maximum height of 40 feet and a total length of 970 feet including a 29.7 foot long overflow spillway. In plan the dam essentially has three angle points along its axis and roughly takes the shape of the letter "W". Approximately 285 feet from the left end of the dam, the axis turns approximately 90° to the right and then proceeds approximately 335 feet to a second angle point. The overflow spillway is located near the center of this 335 foot long section. At the second angle point the axis turns approximately 45° to the left and proceeds 160 feet to the third angle point where it deflects approximately 45° back to the right and continues for 190 feet to the right abutment. The outlet works are located 130 feet from the right abutment in this final section of the dam. See Figure 2, page B-1 in Appendix B.

The dam, originally constructed in 1905 - 1906, consisted of an earth embankment with a maximum height of 33 feet, an upstream slope of 1-1/2 horizontal to 1 vertical protected by slope paving on a gravel base, a downstream slope of 2 horizontal to 1 vertical and a crest width of 14 feet. A stone masonry corewall extended

from "good bottom" to 3 feet below the crest of the dam. In 1910 the dam was raised 7 feet by constructing a concrete corewall on the existing stone masonry one and completing the embankments. The present dam has a crest width of 8 feet and a downstream slope of 2 horizontal to 1 vertical for the upper 15 feet and 3 horizontal to 1 vertical for the remaining slope. At the upstream edge of the crest the 1-1/2 horizontal to 1 vertical upstream slope meets the concrete corewall approximately 2.5 - 3 feet below the crest of the dam. See pages B-3 - B-6 in Appendix B.

The overflow spillway consists of a concrete broad-crested weir with concrete training walls. The top of the dam is 4 feet above the top of the spillway and 2.9 feet above the top of 13-inch high flashboards which are normally in place. The flashboards consist of removable timber planks resting against steel pins in the spillway crest. A steel beam and wood deck bridge spans the spillway. The spillway discharge normally flows through a narrow channel excavated into ledge which discharges into a natural streambed below the outlet works. Large spillway flows discharge through an auxiliary channel approximately 100 feet downstream of the dam. See Figure 2, page B-1 in Appendix B.

The outlet works consist of a 20-inch cast iron pipe through the embankment with an upstream gatehouse. There are 3 intake gate valves at varying elevations on the upstream wall of the gatehouse and an outlet sluice gate on the downstream wall.

c. Size Classification - "Intermediate"

According to the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, a dam is classified as

"Intermediate" in size if the height is between 40 feet and 100 feet or the dam impounds between 1,000 Acre-Feet and 50,000 Acre-Feet. The dam has a maximum height of 40 feet and a maximum storage capacity of 945 Acre-Feet. Therefore the dam is classified as "Intermediate" in size based on the height of 40 feet.

d. Hazard Classification - "Significant"

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the hazard classification of the dam is "Significant". A dam failure analysis indicates that Connecticut Route 72 located downstream of the dam would be flooded for a distance of about 2 miles by depths of up to 5 feet as a result of the dam failure. Further downstream the flood waters would overtop Route 72 at several locations, Preston Road and the dam at Bristol Reservoir No. 3 (incorrectly labeled Bristol Reservoir No. 2 on the U.S.G.S. Quadrangle Sheet). The lower portions of a factory complex consisting of several interconnecting buildings located 3 miles below the dam would also be inundated to a maximum depth of about 1 foot.

The dam is classified as "Significant" hazard potential because of the possible loss of a few lives and downstream property damage should the dam fail.

e. Ownership

Bristol Water Department
119 Riverside Street
Bristol, Connecticut 06010
John Burns, Superintendent
(203) 582-7431

f. Operator

Leonard Valentino
Bristol Filter Plant
Off of Clark Avenue
Bristol, Connecticut 06010
(203) 583-6504

g. Purpose of Dam

The dam impounds Bristol Reservoir No. 4, a storage reservoir for public water supply for the Bristol Water Department.

h. Design and Construction History

The dam was constructed in 1905 - 1906 as shown on plans prepared by Freeman C. Coffin, Civil and Hyd. Eng. The dam was raised 7 feet in 1910 - 1911 as shown on plans prepared by Metcalf and Eddy, Consulting Engineers. See pages B-3 - B-6 in Appendix B.

i. Normal Operational Procedures

Water is drawn from the reservoir by opening one of the intake gate valves in the gatehouse, as required to supply water to a downstream distribution reservoir.

1.3 Pertinent Data

a. Drainage Area

The drainage area consists of 1.7 square miles of "rolling" wooded hills with very sparse development. Most of the drainage area is owned by the Bristol Water Department.

b. Discharge at Damsite

Discharge at the damsite is over a 29.7 foot long concrete spillway. The outlet works consist of a 20" cast iron pipe through the dam with an upstream gatehouse. The gatehouse contains 3 intake gate valves at varying elevations and an outlet sluice gate.

1.	Outlet Works (conduits) Size:	12"	12"	20"
	Invert Elevation at Gatehouse:	836.5±	826.5±	816.0*
	Discharge Capacity:	16 cfs	17 cfs	60 cfs
2.	Maximum Known Flood at Damsite:	Unknown		
3.	Ungated Spillway Capacity at Top of Dam:	760 cfs		480 cfs**
	Elevation:	856.0		856.0
4.	Ungated Spillway Capacity at Test Flood Elevation:	820		
	Elevation:	856.2		
5.	Gated Spillway Capacity at Normal Pool Elevation:	N/A		
	Elevation:	N/A		
6.	Gated Spillway Capacity at Test Flood Elevation:	N/A		
	Elevation:	N/A		
7.	Total Spillway Capacity at Test Flood Elevation:	820 cfs		
	Elevation:	856.2		
8.	Total Project Discharge at Top of Dam:	760 cfs		480 cfs**
	Elevation:	856.0		856.0
9.	Total Project Discharge at Test Flood Elevation:	1410 cfs		
	Elevation:	856.2		

*At outlet
**with 13-inch Flashboards

c. Elevation - Feet Above Mean Sea Level (NGVD)

1.	Streambed at Toe of Dam:	816.0
2.	Bottom of Cutoff:	Unknown
3.	Maximum Tailwater:	N/A
4.	Normal Pool:	853.1 (with flashboards)
5.	Full Flood Control Pool:	N/A
6.	Spillway Crest:	852.0
7.	Design Surcharge - Original Design:	Unknown
8.	Top of Dam:	856.0
9.	Test Flood Surcharge:	856.2

d. Reservoir - Length in Feet

1.	Normal Pool:	4,100'
2.	Flood Control Pool:	N/A
3.	Spillway Crest Pool:	4,100'
4.	Top of Dam:	4,400'
5.	Test Flood Pool:	4,400'

e. Storage - Acre-feet

1.	Normal Pool:	807 (with flashboards)
2.	Flood Control Pool:	N/A
3.	Spillway Crest Pool:	764
4.	Top of Dam:	945
5.	Test Flood Pool:	1000

f. Reservoir Surface - Acres

1.	Normal Pool:	45 (with flashboards)
2.	Flood-Control Pool:	N/A
3.	Spillway Crest:	43
4.	Test Flood Pool:	50
5.	Top of Dam:	50

g. Dam

1.	Type:	Earth embankment, at upstream edge of crest corewall meets upstream slope 2.5' - 3' below the crest.
2.	Length:	970'
3.	Height:	40'
4.	Top Width:	8 foot earth embankment, 16-inch corewall
5.	Side Slopes:	Upstream - 1.5 horizontal to 1 vertical Downstream - 2 horizontal to 1 vertical (upper 15') 3 horizontal to 1 vertical (remaining height)
6.	Zoning:	Embankment upstream of corewall to be "selected material, the most impervious available"; downstream of corewall to be "selected material, the most porous available"
7.	Impervious Core:	Lower portion rubble masonry; upper 10' of concrete
8.	Cutoff:	Rubble masonry corewall extended to "good bottom"
9.	Grout Curtain:	None
10.	Other:	

h. Diversion and Regulating Tunnel - N/A

i. Spillway

1.	Type:	Concrete broad-crested weir
2.	Length of Weir:	29.7
3.	Crest Elevation with Flashboards: without Flashboards:	 853.3 852
4.	Gates:	N/A
5.	Upstream Channel:	Concrete training walls
6.	Downstream Channel:	Below concrete apron, channel is in ledge. Heavy riprap placed on channel banks where channel bends back toward downstream toe.
7.	General:	Normal spillway discharge flows through narrow channel excavated in ledge, large discharges flow through auxiliary channel.

j. Regulating Outlets

1.	Invert at Gatehouse:	836.5	826.5	816*
2.	Size:	12"	12"	20"
3.	Description:	2-12" and 1-20" cast iron pipe from upstream slope to gatehouse; 1-20" cast iron pipe from the gatehouse to downstream toe		
4.	Control Mechanism:	3 manually operated intake gate valves and 1 manually operated outlet sluice gate in upstream gatehouse		
5.	Other:	Maximum capacity - 60 cfs		

*at outlet

ENGINEERING DATA
SECTION 2

2.1 Design Data

Design data for the original construction of the dam consists of two drawings, one entitled "Bristol Water Works, Drawings of Dam, Gridley Pond" and the other entitled "Bristol Water Works, Dam at Gridley Pond, Sections Through Embankment and Drawings of Gate House". Both drawings were dated March 1905 and were prepared by Freeman C. Coffin, Civil and Hyd. Eng., 53 State Street, Boston. Design data for the raising of the dam consisted of two drawings prepared for the Bristol Water Company by Metcalf and Eddy, Consulting Engineers, Boston, Massachusetts. One drawing dated August 20, 1910 is entitled "Plan for Raising Dam No. 4 to 7 Ft. Above Its Present Location". The other drawing is entitled "Spillway and Channel Walls after Raising Water Level 7 Feet" and is dated September 16, 1910.

2.2 Construction Data

Construction data consisted of the above-noted plans. The "Plan for Raising Dam No. 4" was marked up in red pencil to indicate the conditions when work was stopped October 20, 1910. The spillway, the upstream face of the exposed portion of the corewall and the gatehouse were reportedly gunited about 8 years ago by Penetryn Systems, Inc.

2.3 Operation Data

Lake levels are recorded once a month, and do not necessarily coincide with maximum water levels. The amount of flow over the spillway during the August and October 1955 Floods is unknown

because the area was inaccessible due to downstream flooding.

An inspection report prepared by S.E. Minor and Company, Inc., Civil Engineers for the State of Connecticut Department of Environmental Protection in 1975 was available and reviewed. See pages B-7 - B-9 in Appendix B.

2.4 Evaluation of Data

a. Availability

Existing data was provided by the Bristol Water Department and the State of Connecticut Department of Environmental Protection.

b. Adequacy

The information that was available, along with the visual inspection, past performance history, and hydraulic and hydrologic calculations performed for this report, were adequate to assess the condition of the dam.

c. Validity

Field inspections and surveys revealed that the dam is constructed substantially as shown on the existing drawings.

VISUAL INSPECTION

SECTION 3

3.1 Findings

a. General

The visual inspection of the dam was conducted on April 28, 1981. At the time of inspection the water level was at the top of 13-inch high flashboards.

The dam consists of an earth embankment structure with a concrete overflow spillway and outlet works. A concrete corewall on the upstream edge of the crest meets the upstream slope approximately 2.5 - 3 feet below the top of the dam, Photo 1. In plan the dam has three angle points along its axis and roughly takes the shape of the letter "W".

The general condition of the dam at the time of inspection was fair.

b. Dam

The upstream slope of the dam, below the water level, is protected by a layer of riprap slope paving which appears to be in good condition, Photo 2. A concrete facing has been placed at the junction of the upstream slope with the corewall along portions of the dam. The facing is cracked and broken, Photo 2. The upstream face of the concrete corewall appears to be in good condition.

The crest of the dam is covered with a well-maintained grass cover, Photo 3. Sections of the crest appeared to have settled below the top of the corewall, Photo 3, but for the most part the crest was approximately level with the top of the corewall.

The downstream slope of the dam is covered with a well-maintained grass cover, Photos 4 and 5. Several animal burrows were observed on the downstream slope to the left of the spillway, Photo 4. The animal burrows had been backfilled and stabilized with grass. Immediately downstream of the toe, trees have recently been cut from the area to the left of the spillway, Photo 4. Trees are also present at the toe of the dam starting approximately 100 feet to the right of the spillway and ending near the outlet works, Photo 10, and at the intersection of the downstream slope with the right abutment. The area between the dam and Connecticut Route 72 is wet, Photo 5. The ponded water is probably due to a combination of seepage and highway runoff. Approximately 60 feet to the left of the spillway a very small amount of clear seepage was flowing from a wet area downstream of the dam, Photo 6. The area was covered with rust-colored floccules, with adjacent areas stained a rust color.

c. Appurtenant Structures

The appurtenant structures consist of the overflow spillway, a service bridge over the spillway, and the outlet works.

Spillway

The overflow spillway consists of a concrete weir, training walls and apron, Photo 7. Flashboards with a height of 13 inches were in place at the time of inspection. The weir, training walls and apron have been gunited, a thin layer of which appears to be peeling off in some areas. At the base of the training walls there is a separation between the gunite on the walls and the apron, Photo 8. Several hairline cracks were observed in the gunite on

the apron. The end of the spillway apron is undermined, Photo 9. Immediately downstream of the spillway apron, the discharge channel is in ledge. Where the channel bends back toward the toe of the dam, the slopes are protected with heavy riprap, Photo 10.

Service Bridge

The service bridge over the spillway consists of a wood deck supported by steel beams which bear on the training walls, Photo 7. The bridge appears to be in good condition, however, the steel beams are not painted and were rusted.

Outlet Works

The outlet works consist of a 20-inch cast iron pipe through the earth embankment and a gatehouse at the crest of the dam. The gatehouse contains three manually operated intake gates at varying elevations, and an outlet sluice gate. All gates were reported to be operable. The outside of the brick gatehouse has been gunited and appears to be in good condition, Photo 11. The floor of the gatehouse consists of a wood grating. Efflorescence is present on the inside of the concrete walls of the structure. The end wall at the discharge end of the 20-inch cast iron pipe is badly deteriorated, Photo 12. Immediately below the end wall there is what appears to be a seep coming from under one of the stones in the outlet channel. Water flowing from this area transported rust-colored floccules, Photo 13.

d. Reservoir Area

There were no signs of instability along the edges of the reservoir in the vicinity of the dam. An area adjacent to the left of the dam appeared to be lower in elevation than the top of the dam. Connecticut Route 72 crosses the reservoir approximately 3,000 feet north of the dam.

e. Downstream Channel

The discharge channel for the outlet works is the natural streambed of the Poland River, Photo 14. Normal spillway flows discharge into this channel through a narrow channel excavated in ledge, Photo 15. Large spillway flows discharge through an auxiliary channel approximately 100 feet downstream of the dam. This channel is lined with boulders and is overgrown with numerous large trees, Photo 16.

3.2 Evaluation

On the basis of the visual inspection, the dam is judged to be in fair condition. The following features could affect the future integrity of the dam:

1. Seepage downstream of the dam could lead to piping and internal erosion;
2. The trees adjacent to the downstream toe could lead to the development of root systems extending into the embankment. The trees could uproot during a storm and cause damage to the embankment. Stumps and root systems can rot, providing paths for seepage;
3. Continued undermining of the spillway apron could lead to the eventual failure of the apron;
4. Continued deterioration of the outlet works end wall could lead to the eventual collapse of the wall;
5. The trees present in the auxiliary spillway discharge channel could obstruct flow.

SECTION 4

4.1 Operational Data

a. General

Water is drawn from the reservoir by opening one of the intake gates within the gatehouse as required, to supply water to a downstream distribution reservoir.

b. Description of Any Warning System in Effect

There is no formal warning system in effect. The dam is monitored during heavy rains.

4.2 Maintenance Procedures

a. General

Normal maintenance procedures consist of regular mowing and the application of fertilizer and lime to grassed areas of the dam.

b. Operating Facilities

Repairs are made as required.

4.3 Evaluation

Present operations and maintenance procedures are adequate and should remain in effect. An Operations and Maintenance Manual should be prepared for the dam and operating facilites, a formal downstream warning system should be put into effect and technical inspections by a qualified, registered engineer should be made annually.

SECTION 5

5.1 General

The spillway at Bristol Reservoir No. 4 Dam consists of a 29.7 foot long broad-crested concrete overflow weir with a vertical upstream face and a slope of 1 horizontal to 3 vertical on the downstream face. At the time of inspection 13-inch high flashboards were in place. A bridge spans the spillway with 3.1 feet of vertical clearance between the upstream beam and the spillway. The crest of the dam is 4.0 feet above the spillway.

The dam has a maximum height of 40 feet and a storage capacity of 945 Acre-Feet at the top of the dam.

The tributary watershed area is 1.7 square miles of "rolling" wooded hills with very sparse development. Most of the watershed is owned by the Bristol Water Department. The watershed elevations range from 1120 feet in the northeast to 852 feet at the spillway.

The outlet works consist of a 20-inch cast iron pipe through the dam with an upstream gatehouse. There were two 12-inch and one 20-inch intake gates on the upstream wall of the gatehouse and one 20-inch outlet sluice gate on the downstream wall. The outlet works have a maximum capacity of about 60 cfs.

5.2 Design Data

Original plans for the dam dated March 1905 were available as well as plans for raising the dam dated August 20 and September 16, 1910. The plans include details of the gate chamber and outlet piping and the spillway. No design computations were available.

5.3 Experience Data

The maximum depth of flow over the spillway is unknown. The dam has never been known to have overtopped. The dam was inaccessible during the August and October 1955 floods because of downstream flooding.

5.4 Test Flood Analysis

Based on the dam failure analysis, the dam is classified as "Significant" hazard potential. The dam is classified as "Intermediate" in size based on a height of 40 feet and a storage capacity of 945 Acre-Feet. According to the Recommended Guidelines for Safety Inspection of Dams, by the Corps of Engineers, the Test Flood should be in the range of one-half the Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). A Test Flood equal to the 1/2 PMF was selected because the height and storage capacity of the dam are low for an "Intermediate" sized structure.

A Test Flood equal to the 1/2 PMF was calculated using a peak inflow for the PMF of 2,125 cubic feet per second per square mile (csm) from the minimum two square mile drainage area shown on the Corps of Engineers' Guide Curves for "rolling" terrain and the 1.7 square mile watershed of Bristol Reservoir No. 4 Dam. The peak 1/2 PMF inflow calculated to be 1,840 cfs results in a Test Flood routed outflow of 1,410 cfs which would overtop the dam by 0.2 feet. Initial water level was assumed to be at spillway level with no flashboards. The flood routing through the reservoir was done in accordance with the Corps of Engineers' "Estimating Effect of Surcharge Storage on Probable Maximum Discharges". The spillway capacity without flashboards was calculated to be 760 cfs or

54 percent of the 1/2 PMF Test Flood routed outflow. With the 13-inch high flashboards which are normally in place the spillway capacity is 480 cfs or 34 percent of the Test Flood routed outflow.

5.5 Dam Failure Analysis

A dam failure analysis was made using the Corps of Engineers' ' "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs'. Failure was assumed when the water level reached the top of the dam. The 40 foot deep by 50 foot wide breach would release up to 21,300 cfs into the stream channel below the dam.

The flood wave would produce depths of 10 to 18 feet in the Poland River overtopping Connecticut Route 72 for a distance of about 2 miles by depths of up to 5 feet. Further downstream, the flood would overtop Route 72 at several locations, Preston Road and the dam at Bristol Reservoir No. 3 (incorrectly labeled Bristol Res. No. 2 on the U.S.G.S. Quadrangle Sheet). The flood flow at a factory complex located 3 miles below the dam would have a depth of about 7 feet, and would inundate the lower portions of the factory to a depth of about 1 foot. The factory complex is operated by O-Z/Gedney and consists of several interconnected buildings. See Figures 5 and 5A, pages D-47 and D-48 in Appendix D.

Prior to dam failure the spillway discharge of 760 cfs would have an average depth of flow of about 5 feet with a maximum depth of 10 feet and would not overtop Route 72 or any of the downstream roadways. The depth of flow in the river channel at the factory complex would be about 3 feet with no flooding anticipated.

The dam is classified as "Significant" hazard potential because of the possible loss of a few lives and downstream property damage should the dam fail.

EVALUATION OF STRUCTURAL STABILITY

SECTION 6

6.1 Visual Observations

The visual observations did not disclose any indications of structural instability. The future integrity of the dam may be affected by continued seepage downstream of the dam and undermining of the spillway apron.

6.2 Design and Construction Data

Design and construction data consisted of drawings for the original construction of the dam prepared by Freeman C. Coffin, Civil and Hyd. Eng., in 1905 and drawings for the raising of the dam prepared by Metcalf and Eddy, Consulting Engineers in 1910.

6.3 Post-Construction Changes

Since the original construction of the dam in 1905, the dam has been raised 7 feet in 1910 - 1911. Gunite repairs were made by Penetryn Systems, Inc. about 8 years ago to the spillway, the exposed portion of the corewall and the gatehouse.

6.4 Siesmic Stability

The dam is located in Seismic Zone 1 and in accordance with the recommended Phase I Guidelines, does not warrant seismic stability analysis.

7.1 Dam Assessment

a. Condition

On the basis of the visual inspection, the dam is judged to be in fair condition. The future integrity of the dam could be affected by:

1. Downstream seepage;
2. Trees growing adjacent to the downstream toe and in the auxiliary spillway channel;
3. Continued undermining of the spillway apron; and
4. Continued deterioration of the outlet works endwall.

An evaluation of the hydraulic and hydrologic features of the dam determined that the spillway is capable of passing 54 percent of the Test Flood routed outflow before overtopping of the dam occurs.

b. Adequacy of Information

Available information was adequate for performing a Phase I Inspection.

c. Urgency

The recommendations presented in Section 7.2 and 7.3 should be carried out by the owner within one year of receipt of this report.

7.2 Recommendations

The following recommendations should be carried out under the direction of a qualified, registered engineer:

1. Investigate the significance of the seepage at the downstream toe and in the outlet works channel. Design and construct seepage control and/or monitoring measures as needed.
2. Investigate the undermining of the spillway apron and recommend remedial measures as required.
3. Perform a detailed hydraulic and hydrologic analysis in order to determine the need for and means to provide additional project discharge capacity and the effect of the service bridge on the spillway capacity.
4. Remove trees and stumps from the area within 20 feet of the downstream toe.

The owner should implement all recommendations made by the engineer.

7.3 Remedial Measures

a. Operations and Maintenance Procedures

1. Cut trees from the auxiliary spillway channel.
2. Repair or replace the outlet works endwall.
3. Remove the flashboards until detailed hydraulic and hydrologic analysis has been performed and recommendations implemented.
4. Establish a program of annual technical inspections to be made by a qualified, registered engineer.
5. Prepare an Operations and Maintenance Manual for the dam and operating facilities.
6. Develop and put into effect a downstream warning system in the event of an emergency at the dam.

7.4 Alternatives

There are no practical alternatives to the recommendations contained herein.

APPENDIX A

VISUAL CHECK LIST WITH COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT: Bristol Reservoir No. 4 Dam

DATE: 28 April 1981 TIME: 10:45 a.m. WEATHER: Cloudy 55°F

W.S. ELEVATION: 853.1 (Top of 13-inch high flashboards) U.S. N/A DN.S

	PARTY	DISCIPLINE
1.	Roald Haestad, P.E. - Roald Haestad, Inc.	Civil/Geotechnical
2.	Donald L. Smith, P.E. - Roald Haestad, Inc.	Civil/Hydrologic
3.	Ronald G. Litke, P.E. - Roald Haestad, Inc.	Civil/Structural
4.		
5.		
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam Embankment	RH,DLS,RGL	Good condition
2.	Outlet Works - Intake Channel & Intake Structure	RH,DLS,RGL	None observed
3.	Outlet Works - Control Tower	RH,DLS,RGL	Good condition
4.	Outlet Works - Transition & Conduit	RH,DLS,RGL	20-inch cast iron pipe through dam
5.	Outlet Works - Outlet Structure & Outlet Channel	RH,DLS,RGL	Endwall deteriorated; channel is natural stream
6.	Outlet Works - Spill. Weir, Appr. & Dis. Channel	RH,DLS,RGL	Undermining at end of spillway apron
7.	Outlet Works - Service Bridge	RH,DLS,RGL	Good condition
8.			
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 4 Dam DATE: 28 April 1981

PROJECT FEATURE: Dam Embankment NAME: RH

DISCIPLINE: Civil Engineers NAME: DLS,RCL

AREA ELEVATION	CONDITIONS
DAM EMBANKMENT	
CREST ELEVATION	856
CURRENT POOL ELEVATION	853.1
MAXIMUM IMPOUNDMENT TO DATE	Unknown
SURFACE CRACKS	None observed
PAVEMENT CONDITION	No pavement - crest is grass-covered
MOVEMENT OR SETTLEMENT OF CREST	Possible settlement of crest downstream of corewall.
LATERAL MOVEMENT	None observed
VERTICAL ALIGNMENT	Good
HORIZONTAL ALIGNMENT	Good
CONDITION AT ABUTMENT AND AT CONCRETE STRUCTURES	Some settlement downstream of corewall.
INDICATIONS OF MOVEMENT OF STRUCTURAL ITEMS ON SLOPES	No structural items on slopes
TRESPASSING ON SLOPES	Some animal burrows on downstream slope
VEGETATION ON SLOPES	Well-maintained grass cover
SLOUGHING OR EROSION OF SLOPES OR ABUTMENTS	None observed
ROCK SLOPE PROTECTION - RIPRAP FAILURES	Riprap slope paving on upstream; slope in good condition
UNUSUAL MOVEMENT OR CRACKING AT OR NEAR TOES	None observed
EMBANKMENT OR DOWNSTREAM SEEPAGE	Wet area between left end of dam and Route 72. Small seep 60 feet to left of spillway.
PIPING OR BOILS	None observed
FOUNDATION DRAINAGE FEATURES	None known
TOE DRAINS	N/A
INSTRUMENTATION SYSTEM	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 4 Dam DATE: 28 April 1981

PROJECT FEATURE: Outlet Works - Intake Channel and Intake Structure NAME: RH

DISCIPLINE: Civil Engineers NAME: DLS,RGL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	None observed. Plans indicate intake pipes extend from the gatehouse to upstream slope of embankment.
A. APPROACH CHANNEL:	
SLOPE CONDITIONS	
BOTTOM CONDITIONS	
ROCK SLIDES OR FALLS	
LOG BOOM	
DEBRIS	
CONDITION OF CONCRETE LINING	
DRAINS OR WEEP HOLES	
B. INTAKE STRUCTURE:	
CONDITION OF CONCRETE	
STOP LOGS AND SLOTS	

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 4 Dam DATE: 28 April 1981

PROJECT FEATURE: Outlet Works - Control Tower NAME: RH

DISCIPLINE: Civil Engineers NAME: DLS,RGL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
A. CONCRETE AND STRUCTURAL:	
GENERAL CONDITION	Good
CONDITION OF JOINTS	No joints observed
SPALLING	None observed
VISIBLE REINFORCING	None observed
RUSTING OR STAINING OF CONCRETE	None observed
ANY SEEPAGE OR EFFLORESCENCE	Some efflorescence on interior walls
JOINT ALIGNMENT	No joints observed
UNUSUAL SEEPAGE OR LEAKS IN GATE CHAMBER	No leaks or seepage observed; intake gates were open; entire chamber not observed.
CRACKS	None observed
RUSTING OR CORROSION OF STEEL	N/A
B. MECHANICAL AND ELECTRICAL:	
AIR VENTS	N/A
FLOAT WELLS	N/A
CRANE HOIST	N/A
ELEVATOR	N/A
HYDRAULIC SYSTEM	N/A
SERVICE GATES	Reported operable
EMERGENCY GATES	N/A
LIGHTNING PROTECTION SYSTEM	N/A
EMERGENCY POWER SYSTEM	N/A
WIRING AND LIGHTING SYSTEM IN GATE CHAMBER	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 4 Dam DATE: 28 April 1981

PROJECT FEATURE: Outlet Works - Transition and Conduit NAME: RH

DISCIPLINE: Civil Engineers NAME: DLS,RGL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	Conduit is 20-inch cast iron pipe through dam; not observed
GENERAL CONDITION OF CONCRETE	
RUST OR STAINING ON CONCRETE	
SPALLING	
EROSION OR CAVITATION	
CRACKING	
ALIGNMENT OF MONOLITHS	
ALIGNMENT OF JOINTS	
NUMBERING OF MONOLITHS	

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 4 Dam DATE: 28 April 1981

PROJECT FEATURE: Outlet Works - Outlet Structure and Outlet Channel NAME: RH

DISCIPLINE: Civil Engineers NAME: DLS,RGL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
GENERAL CONDITION OF CONCRETE	Poor
RUST OR STAINING	Rust-colored staining in streambed approximately 10' downstream
SPALLING	Considerable spalling and deterioration of concrete endwall
EROSION OR CAVITATION	None
VISIBLE REINFORCING	None observed
ANY SEEPAGE OR EFFLORESCENCE	Possible seepage 10' downstream from under rock in channel
CONDITION AT JOINTS	No joints
DRAIN HOLES	N/A
CHANNEL	Natural stream
LOOSE ROCK OR TREES OVERHANGING CHANNEL	None immediately downstream
CONDITION OF DISCHARGE CHANNEL	Good

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 4 Dam DATE: 28 April 1981

PROJECT FEATURE: Outlet Works - Spillway Weir, Approach & Discharge Channels NAME: RH

DISCIPLINE: Civil Engineers NAME: DLS,RGL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
A. APPROACH CHANNEL:	
GENERAL CONDITION	Good
LOOSE ROCK OVERHANGING CHANNEL	None
TREES OVERHANGING CHANNEL	None
FLOOR OF APPROACH CHANNEL	Could not be observed
B. WEIR AND TRAINING WALLS:	
GENERAL CONDITION OF CONCRETE	Good: thin layer of gunite peeling off in places; undermining at end of apron.
RUST OR STAINING	None observed
SPALLING	Opening between gunite at base of wall; hairline cracks in floor
ANY VISIBLE REINFORCING	None observed
ANY SEEPAGE OR EFFLORESCENCE	None observed
DRAIN HOLES	N/A
C. DISCHARGE CHANNEL:	
GENERAL CONDITION	Good
LOOSE ROCK OVERHANGING CHANNEL	None observed
TREES OVERHANGING CHANNEL	Some small trees on edge of channel.
FLOOR OF CHANNEL	Ledge at end of spillway apron
OTHER OBSTRUCTIONS	Normal flow goes through narrow channel excavated in ledge. Large flows go through auxiliary channel which has numerous trees growing in it.

PERIODIC INSPECTION CHECK LIST

PROJECT: Bristol Reservoir No. 4 Dam DATE: 28 April 1981

PROJECT FEATURE: Outlet Works - Service Bridge NAME: RH

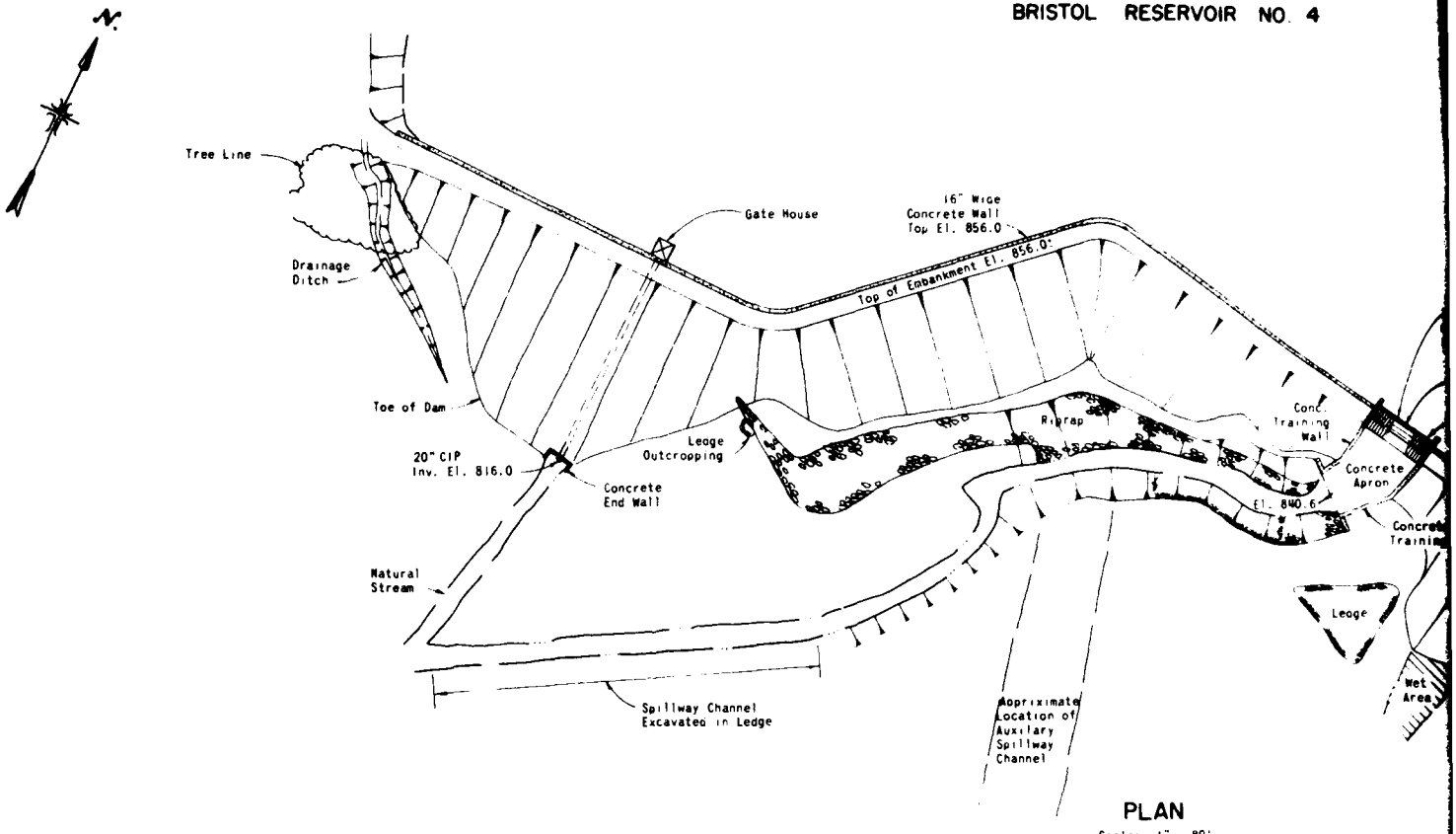
DISCIPLINE: Civil Engineers NAME: DLS,RGL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	
A. SUPER STRUCTURE:	
BEARINGS	Beams appear to bear directly on concrete.
ANCHOR BOLTS	No anchor bolts observed
BRIDGE SEAT	No seat, beams bear on training walls
LONGITUDINAL MEMBERS	Steel beams look good
UNDER SIDE OF DECK	Looks good
SECONDARY BRACING	Appears good
DECK	Wood deck in good condition
DRAINAGE SYSTEM	N/A
RAILINGS	N/A
EXPANSION JOINTS	N/A
PAINT	No paint; portions of beams gunited
B. ABUTMENT AND PIERS:	
GENERAL CONDITION OF CONCRETE	Good
ALIGNMENT OF ABUTMENT	Good
APPROACH TO BRIDGE	Good
CONDITION OF SEAT AND BACKWALL	Beams bear on top of training walls

APPENDIX B

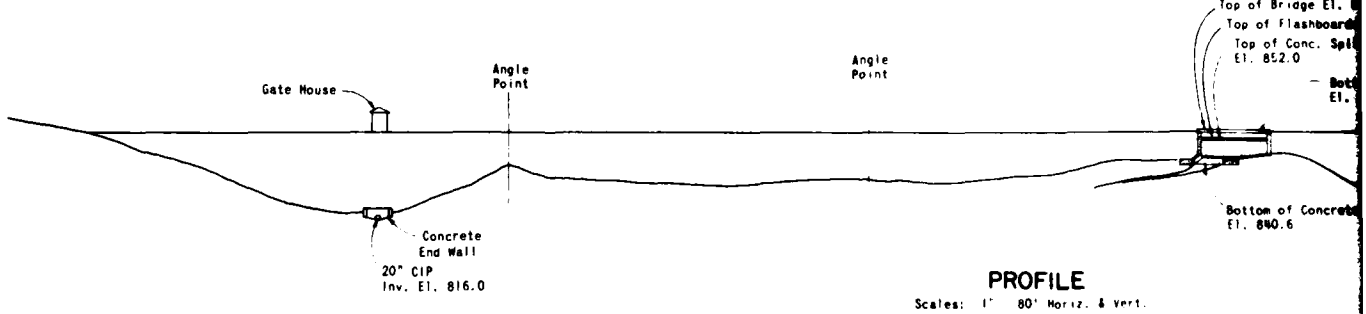
ENGINEERING DATA

BRISTOL RESERVOIR NO. 4



PLAN

Scale: 1" = 80'



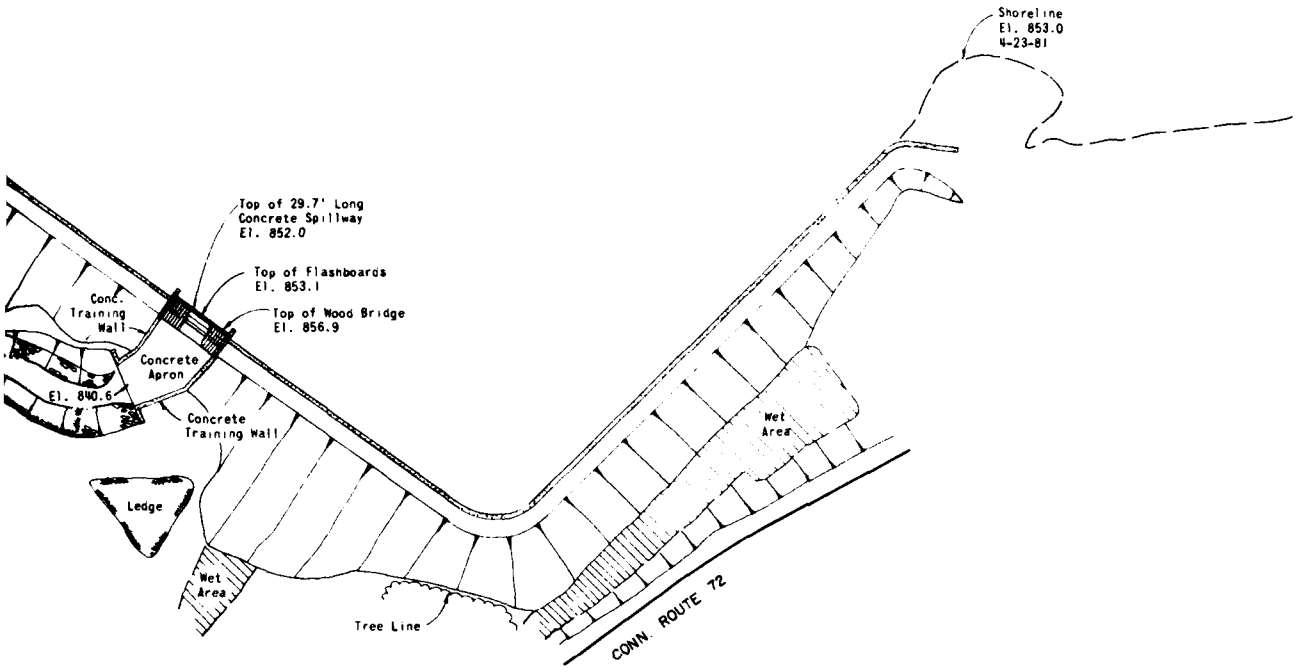
PROFILE

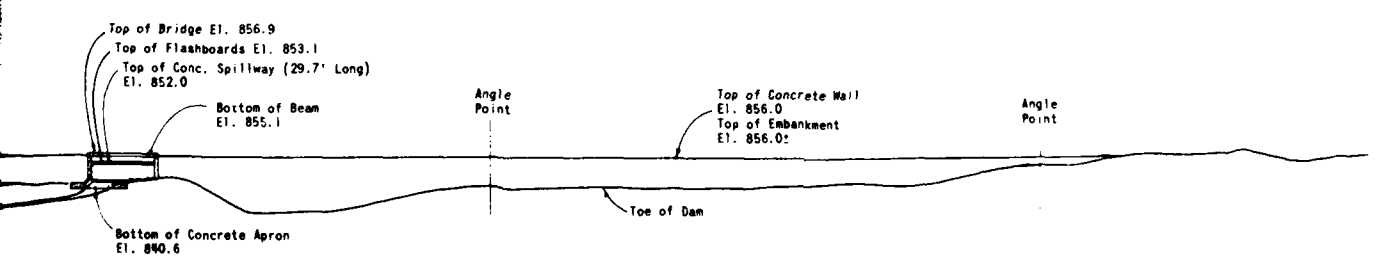
Scales: 1" = 80' Horiz. & Vert.

NOTE: THE WATER SURFACE ELEVATION SHOWN ON THE 1969 THOMASTON U.S.G.S. QUADRANGLE MAP WAS ASSUMED TO BE THE SPILLWAY CREST ELEVATION. ALL OTHER ELEVATIONS ARE BASED ON THE ASSUMED SPILLWAY CREST ELEVATION.

FIGURE 2

IR NO. 4





Vert.

ROALD HAESTAD, INC *CONSULTING ENGINEERS* WATERBURY, CONNECTICUT	U S ARMY ENGINEER DIV NEW ENGLAND *CORPS OF ENGINEERS* WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

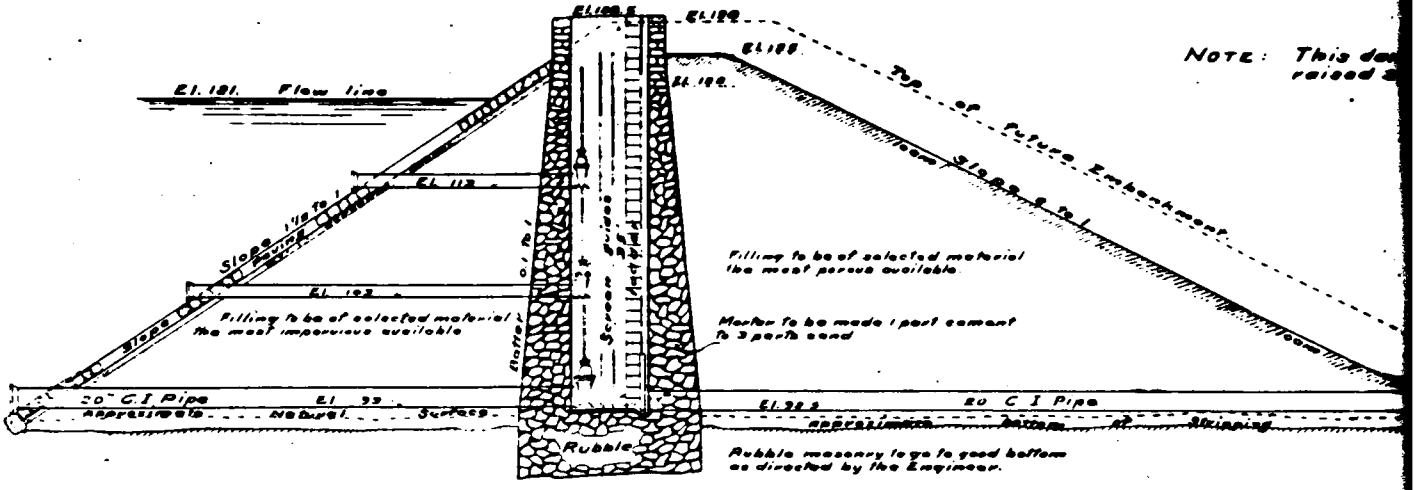
BRISTOL RESERVOIR NO. 4 DAM

DRAWN	CHECKED	APPROVED	SCALES AS NOTED	
JRS	RGL	RH	DATE MAY 1981	PAGE B-1

LIST OF REFERENCES

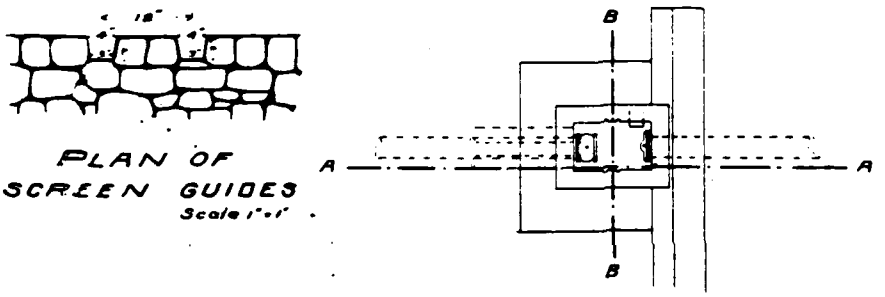
Reference Nos. 1 and 2 are located at the Bristol Water Department, 119 Riverside Street, Bristol, Connecticut 06010. Reference No. 3 is located at the Department of Environmental Protection, Water and Related Resources Unit, State Office Building, Hartford, Connecticut 06115.

1. Plans for the original construction of the dam by Freeman C. Coffin, Civil and Hyd. Eng., March 1905.
2. Plans for the raising of the dam by Metcalf and Eddy, Consulting Engineers, August 20, 1910 and September 16, 1910.
3. Inspection Report by S.E. Minor and Company, Inc., Civil Engineers, for the State of Connecticut Department of Environmental Protection.



SECTION THROUGH GATE HOUSE AND DAM ON LINE A-A

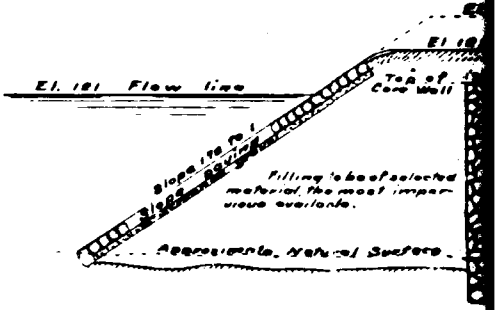
Scale 1/8" = 1'



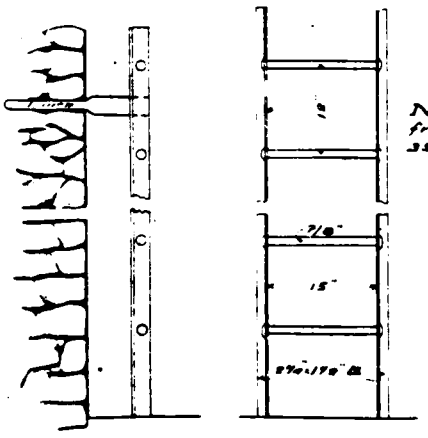
PLAN OF SCREEN GUIDES

Scale 1" = 1'

PLAN OF GATE HOUSE

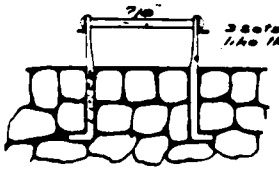


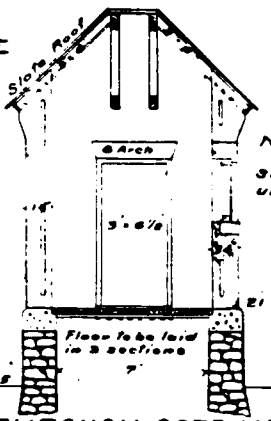
SECTION THROUGH



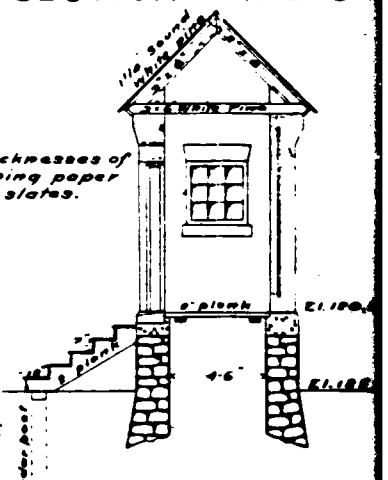
DETAILS OF LADDER

Scale 1" = 1'

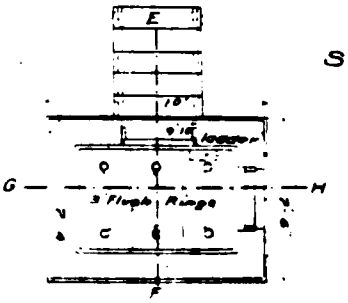




SECTION THROUGH GATE HOUSE ON LINE G-H



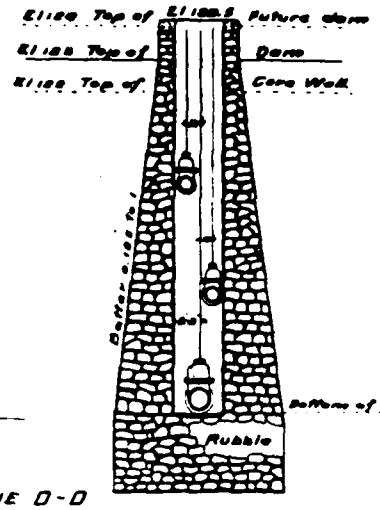
SECTION THROUGH GATE ON LINE E-F

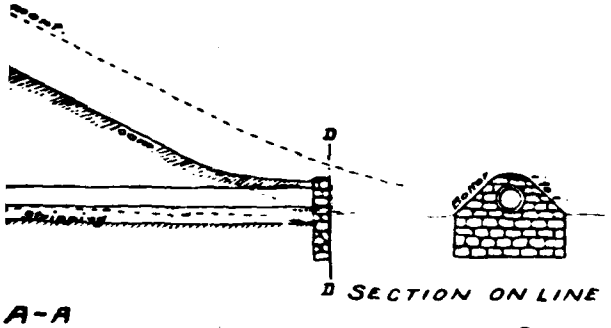


PLAN Scale 1/8" = 1'

Contract does not include ... gate house nor steps.

NOTE: This dam is planned to be raised 3 feet at some future time



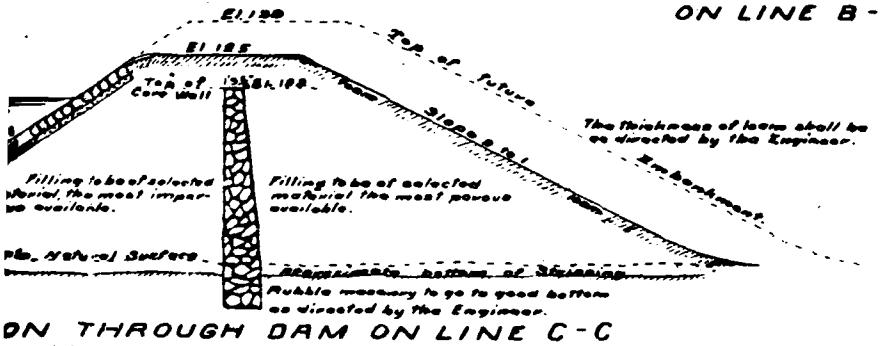


SECTION ON LINE D-D

A-A

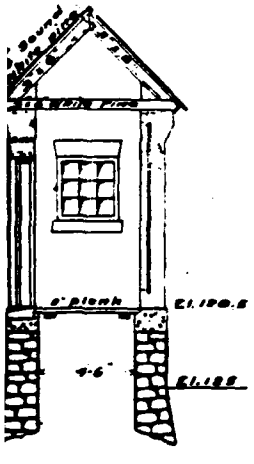
SECTION THROUGH GATE HOUSE ON LINE B-B

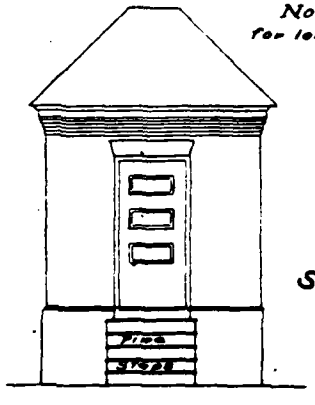
Scale 1/16"=1'



ON THROUGH DAM ON LINE C-C

Note See sheet 35a for location of section





FRONT ELEVATION

Scale 1/8"=1'

BRISTOL WATER WORKS

DAM AT GRIDLEY POND

SECTIONS THROUGH EMBANKMENT AND DRAWINGS OF GATE HOUSE

MARCH 1905

Freeman C. Coffin
Civil and Hyd. Eng.
33 State St. Boston.

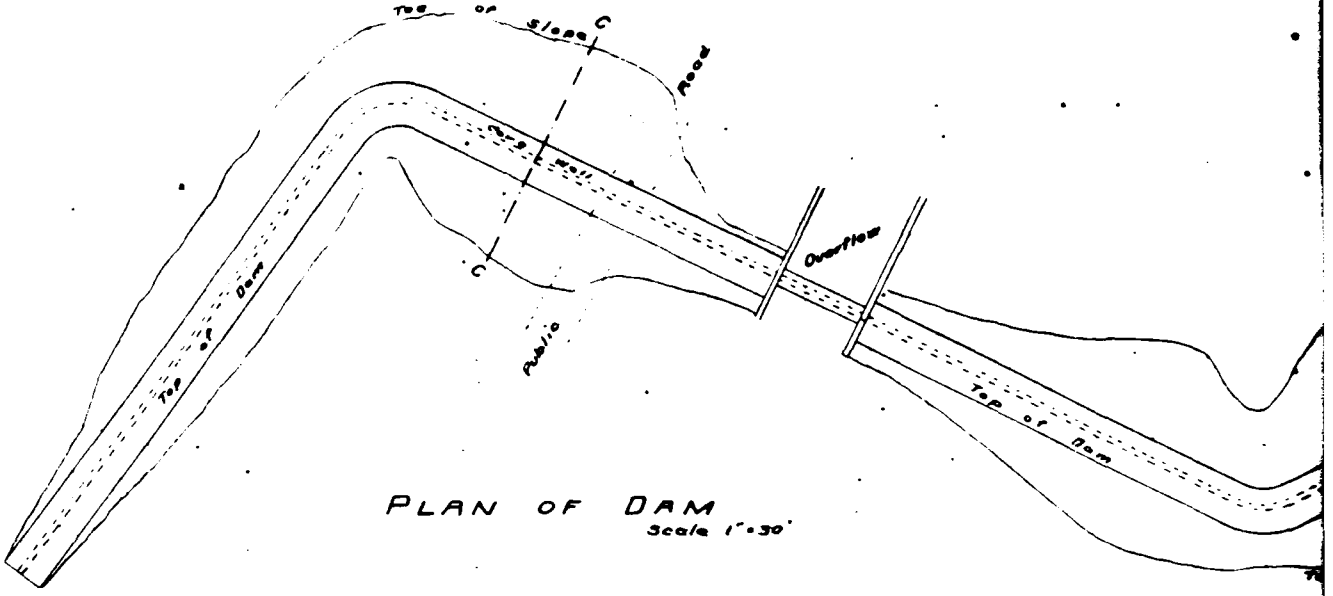
[redacted]

THROUGH GATE HOUSE
LINE E-F

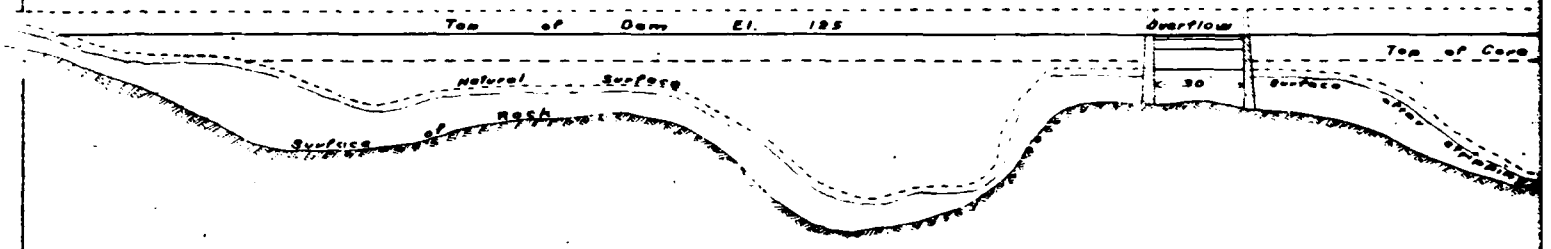
does not include brick
nose steps.

Series B
No. 35P
Del T
Traced R
Mar P 05

B-3



PLAN OF DAM
Scale 1" = 30'

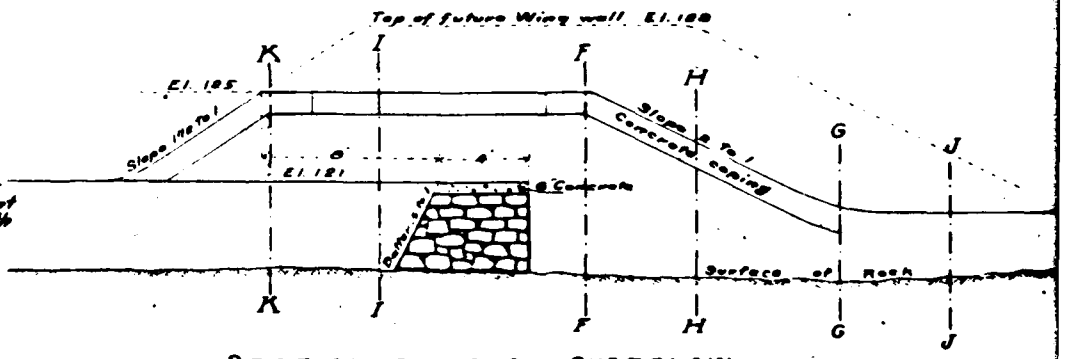


NOTE: This dam is planned to be raised 3 feet at some future time

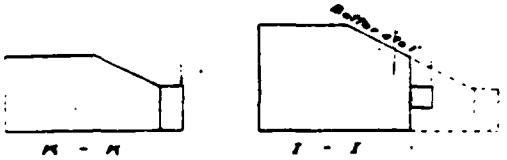
LONGITUDINAL SECTION OF
Scale

NOTE

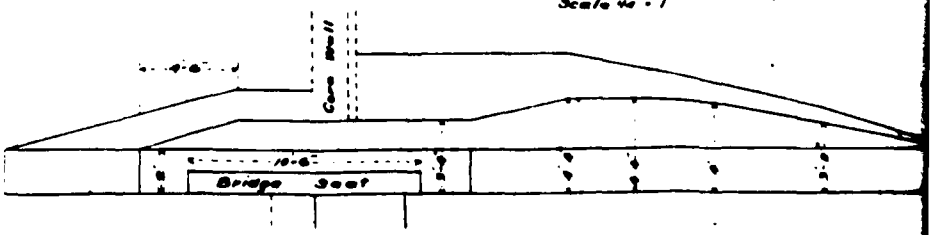
The rock surface shown is that indicated by test pits except under the pond where no pits or borings have been made. The actual rock surface may vary from that shown. The trench for the wall may have to go lower than shown, and the contractor shall have no claim for extra payment per cubic yard for such excess of depth if it does not average more than 50 per cent greater depth than that shown.



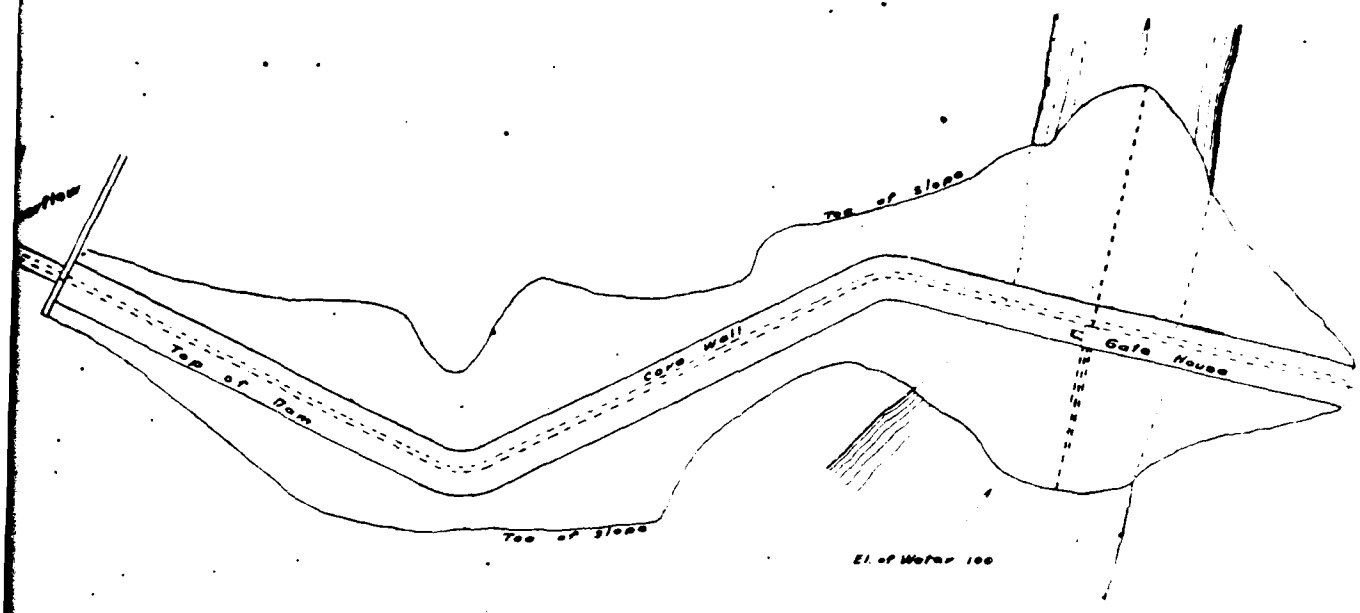
SECTION THROUGH OVERFLOW
Scale 4" = 1'

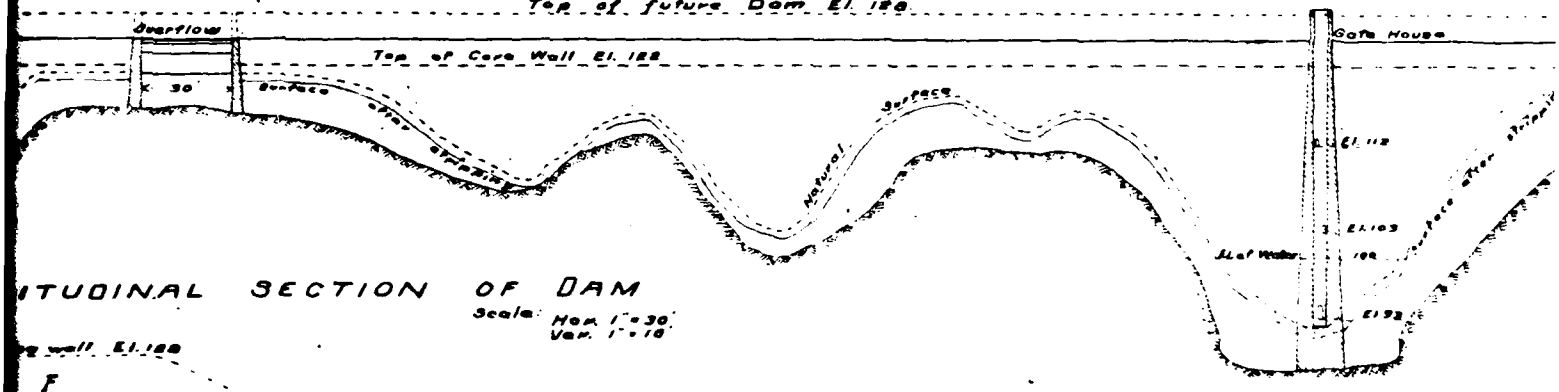


SECTIONS THROUGH ABUTMENT



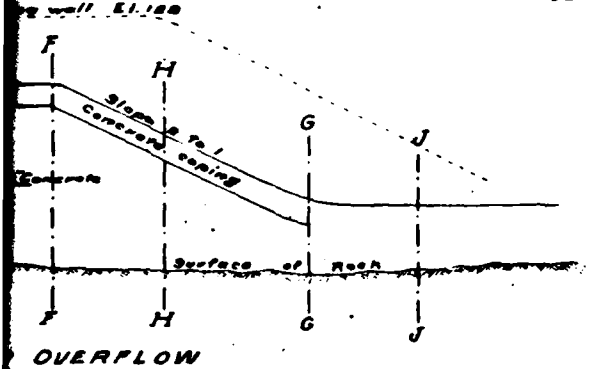
PLAN OF OVERFLOW ABUTMENT





ITUDINAL SECTION OF DAM

Scale: Hor. 1"=30'
Ver. 1"=10'



OVERFLOW

Scale 4"=1'

BRISTOL WATER WORKS

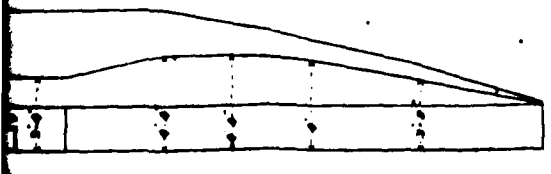
DRAWINGS OF DAM

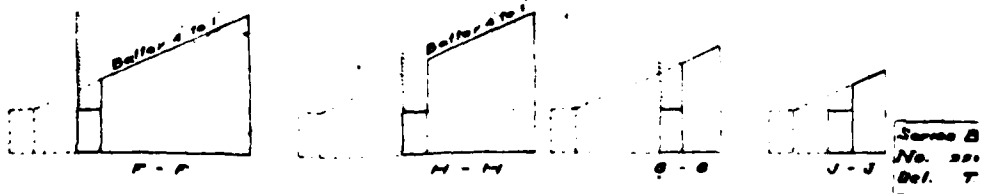
GRIDLEY POND

MARCH 1905

NOT TO SCALE

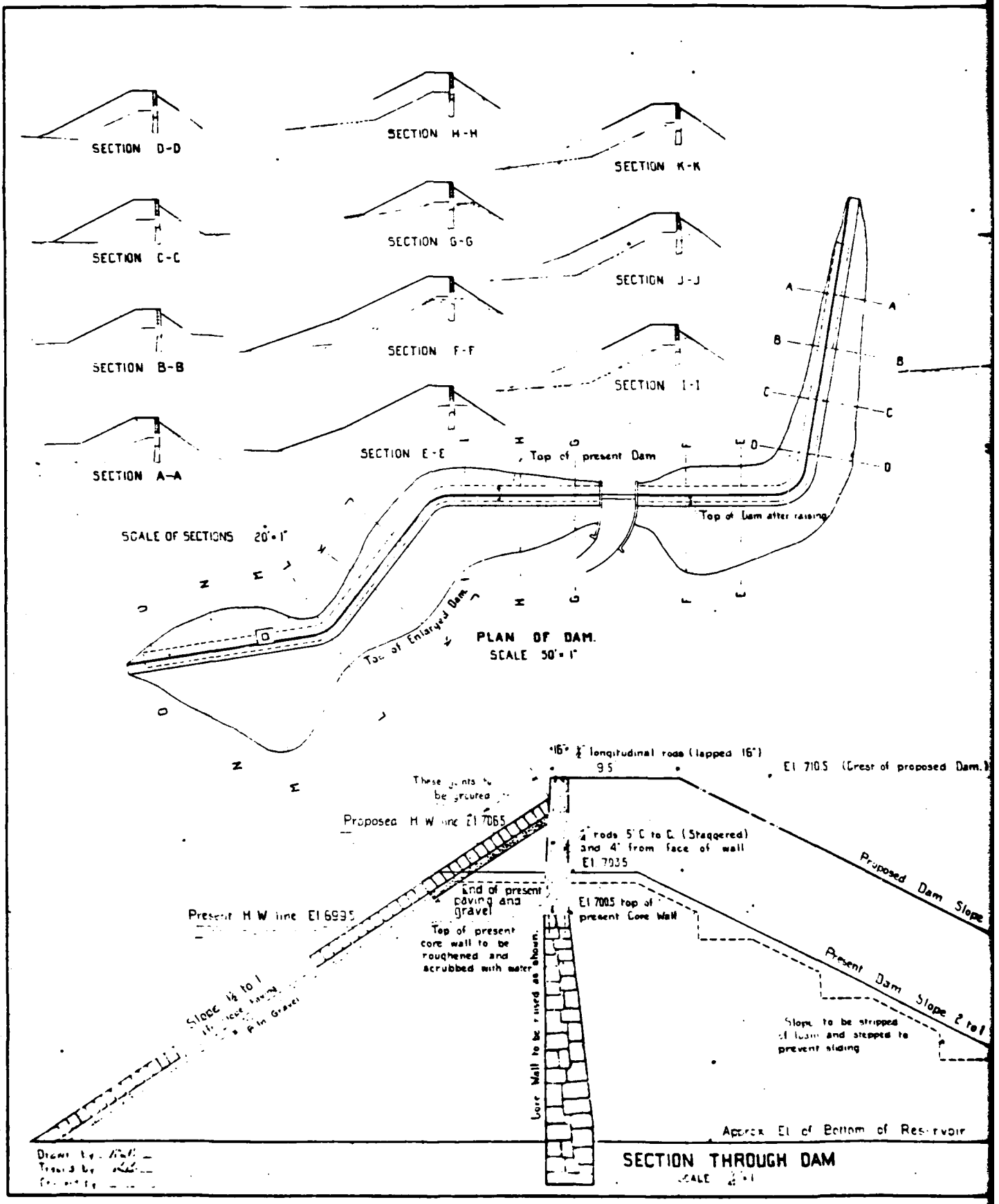
Freeman C Coffin
Civil and Mun. Eng.
33 State St Boston

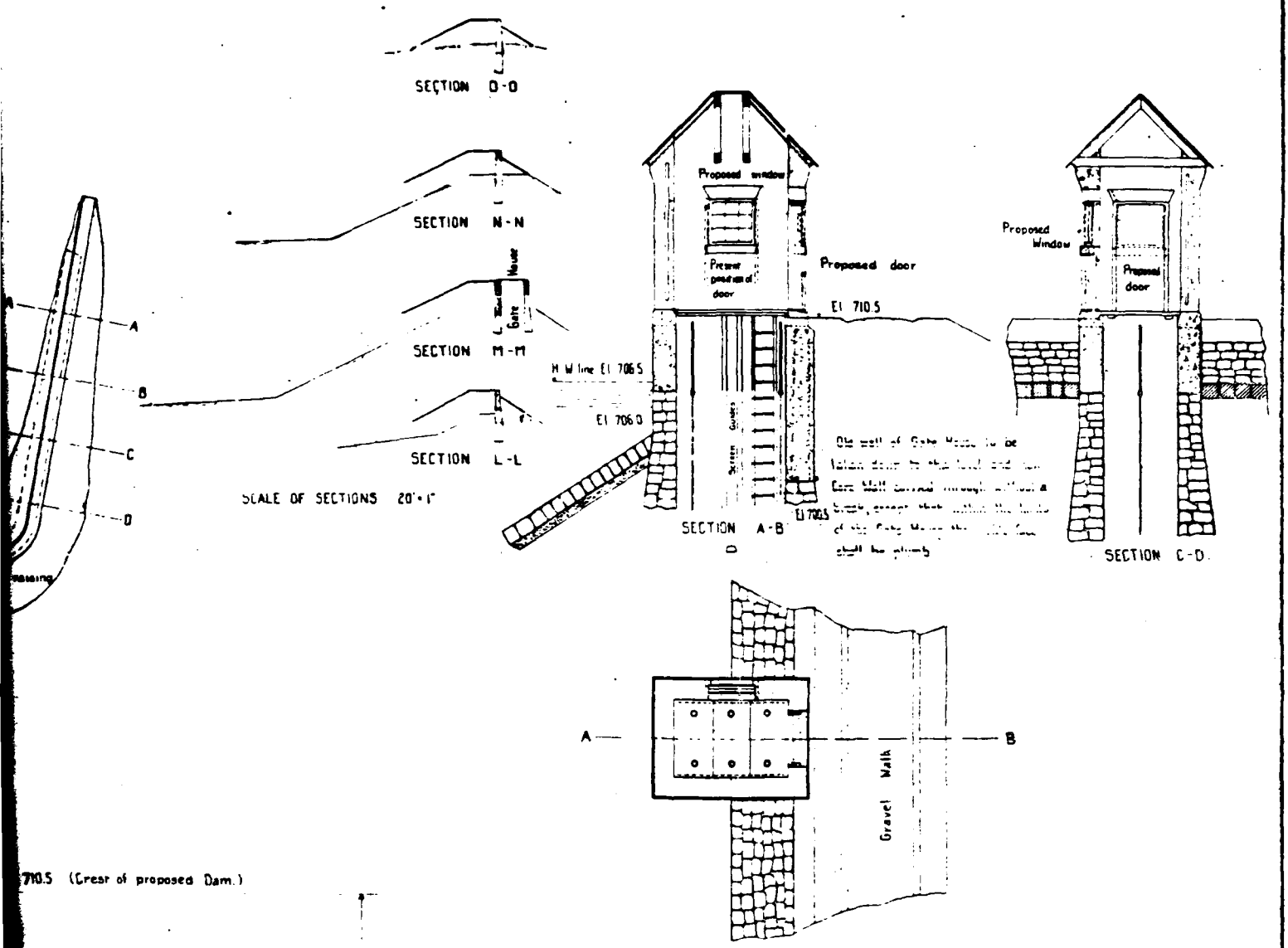




FLOW ABUTMENT

SECTIONS THROUGH ABUTMENT


SECTION D-D
SECTION H-H
SECTION K-K
SECTION C-C
SECTION G-G
SECTION J-J
SECTION B-B
SECTION F-F
SECTION I-I
SECTION A-A
SECTION E-E
Top of present Dam
Top of loam after raising
SCALE OF SECTIONS 20' = 1"
Top of Enlarged Dam
PLAN OF DAM.
SCALE 50' = 1"
16" x ½" longitudinal rods (lapped 16")
9.5
El 710.5 (Crest of proposed Dam.)
These joints to be grouted
Proposed H.W. line El 706.5
4 rods 5' C to C. (Staggered) and 4" from face of wall El 703.5
Proposed Dam Slope
End of present paving and gravel
Present H.W. line El 699.5
El 700.5 top of present Core Wall
Top of present core wall to be roughened and scrubbed with water
Present Dam Slope 2 to 1
Slope to be stripped of loam and stepped to prevent sliding
Core Wall to be raised as shown.
Approx. El of Bottom of Reservoir
SECTION THROUGH DAM



PLAN OF GATE HOUSE
SCALE 1"=1'

710.5 (Crest of proposed Dam.)

15'-0"

Proposed Dam Slope 2 to 1

Present Dam Slope 2 to 1

Slope 3 to 1

to be stripped
and stepped to
sliding.

This part to be filled
with the most porous
material available

Bottom of Reservoir

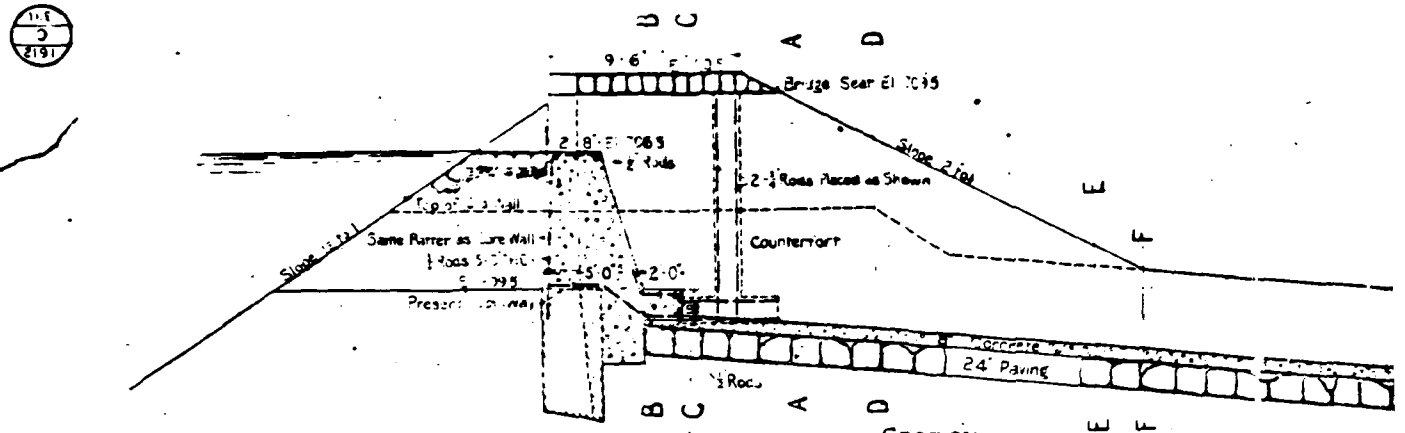
AM

THE BRISTOL WATER CO
BRISTOL CONN.

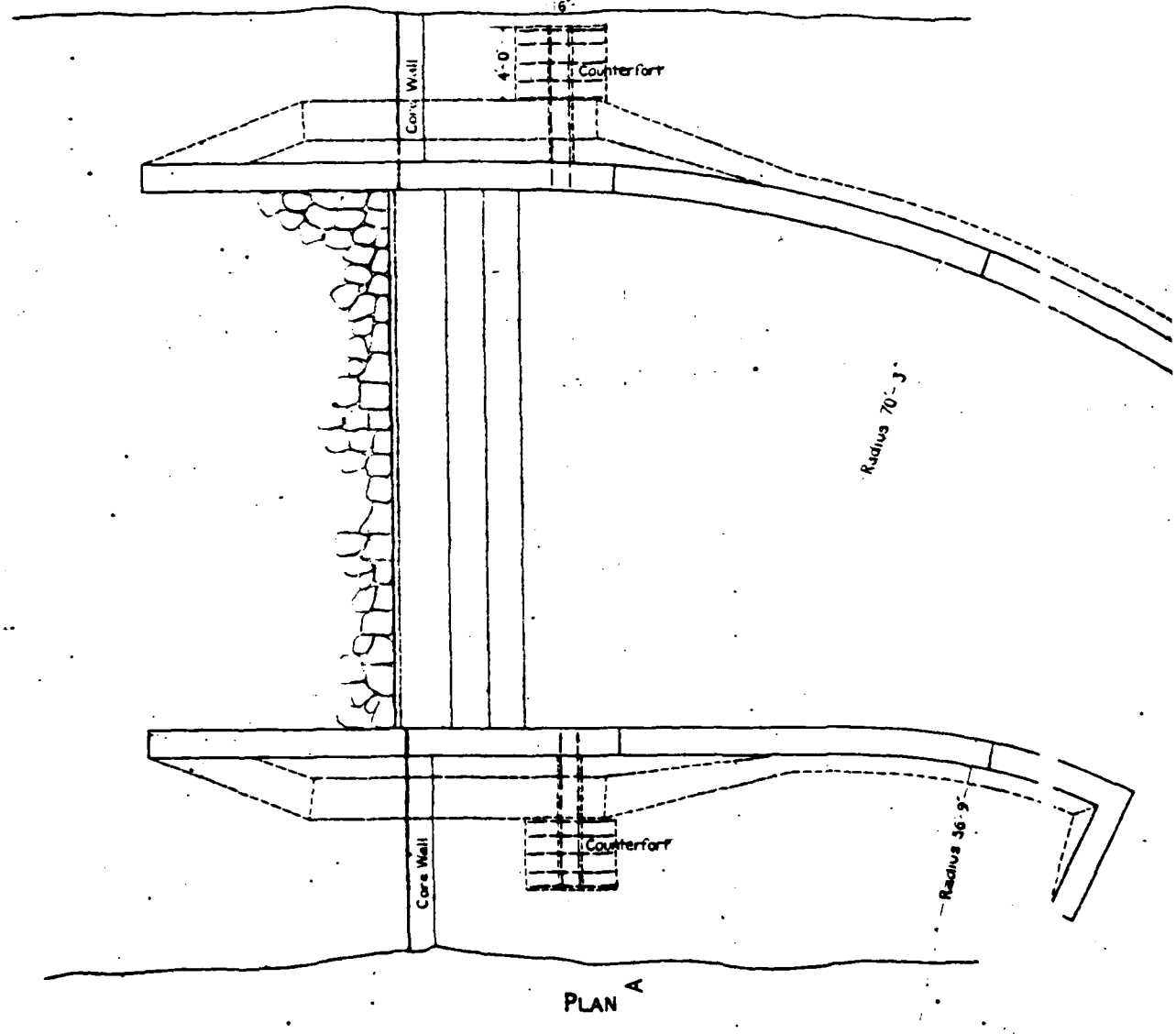
PLAN FOR RAISING DAM NO. 4.

TO 7 FT ABOVE ITS PRESENT LOCATION
SCALES AS SHOWN
AUGUST 20, 1910

METCALF AND EDDY
Consulting Engineers
Boston Mass

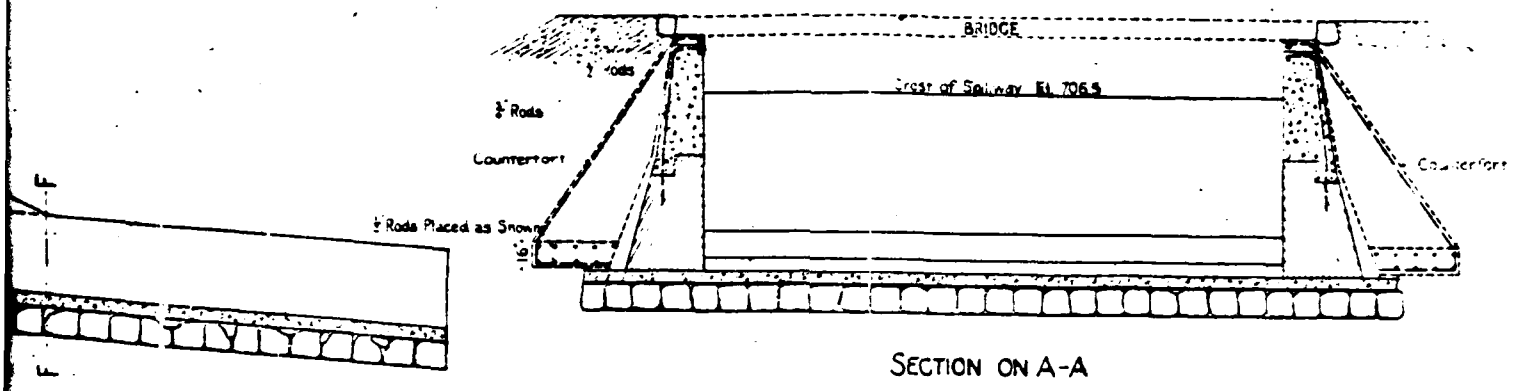


LONGITUDINAL SECTION

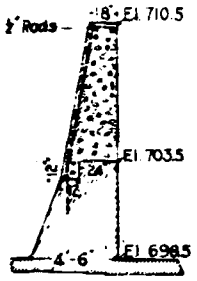


PLAN

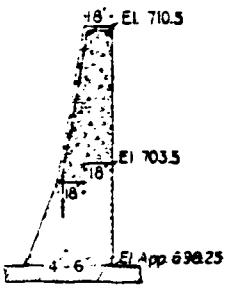
DRAWN BY JAL
TRACED BY JAL
CHECKED BY CWS



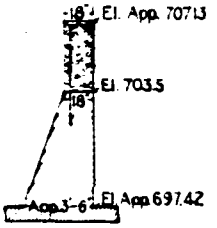
SECTION ON A-A



SECTION ON BB



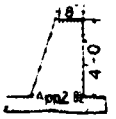
SECTION ON CC



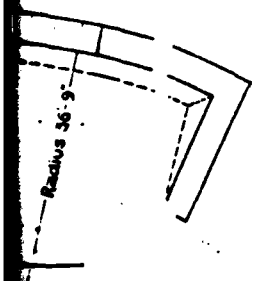
SECTION ON DD

Note – All upright rods to be equiv to ½" round rods and are to be placed 3' on centers in walls

SECTION ON EE



TYPICAL SECTION BELOW FF



THE BRISTOL WATER CO.

BRISTOL, CONN.

SPILLWAY AND CHANNEL WALLS

AFTER RAISING WATER LEVEL 7 FEET

SCALE ¼" TO 1'

SEPT. 16, 1910.

METCALF & EDDY,
CONSULTING ENGINEERS,
BOSTON, MASS.

[redacted]

203-869-0138

ESTABLISHED 1887

S. E. MINOR & CO., INC.
CIVIL ENGINEERS
161 MASON STREET
GREENWICH, CONNECTICUT 06830

October 2, 1975

State of Connecticut
Department of Environmental Protection
State Office Building
Hartford, Connecticut 06115

Attention: Mr. Victor F. Galgowski
Superintendent of Dam Maintenance
Water and Related Resources

Re: Bristol Reservoir #4
Harwinton, Connecticut

Dear Mr. Galgowski:

In accordance with your request, we have examined the subject dam in order to ascertain its structural soundness and stability. Prior to our visit to the site, we went to the Town Hall offices and attempted to obtain any structural drawings of the subject installation. We were advised that no plans were on file and that the Town officials had no knowledge whatsoever of the construction of the dam.

Upon visiting the site, we examined the structure which consists of a masonry back and an earthen top and face. The top of the dam is approximately 8 feet wide, and the face has a slope of about one on two. The length of the dam totals approximately 875 feet and contains a valve house approximately 8 feet by 10 feet in area. There is generally 2 feet 6 inches of freeboard on the masonry back of the dam, and the slope from water level runs back at about a one on three slope which is surfaced with concrete and rubble.

The spillway to the Poland River is 30 feet wide with masonry cheek walls on either side and a wooden bridge on steel girders overhead. The top and face of the dam together with the spillway have been properly maintained, and there was no evidence of fissures, leaks, or boils anywhere throughout the face of the 875 foot dam. There was no evidence of overtopping at any time, and bridge computations of the watershed area indicate that the spillway and Poland River are perfectly capable of taking storms with a frequency less often than once in 25 years.

Re: Bristol Reservoir #4

The enclosed sketch of the dam indicates the general layout of same together with the general dimensions and location of the spillway and bridge. It is our considered opinion that the dam is structurally sound, free from leaks, and that with normal maintenance as evidenced by our visit said dam will remain in service for many years.

Should you have any questions or comments regarding this dam, please feel free to contact me.

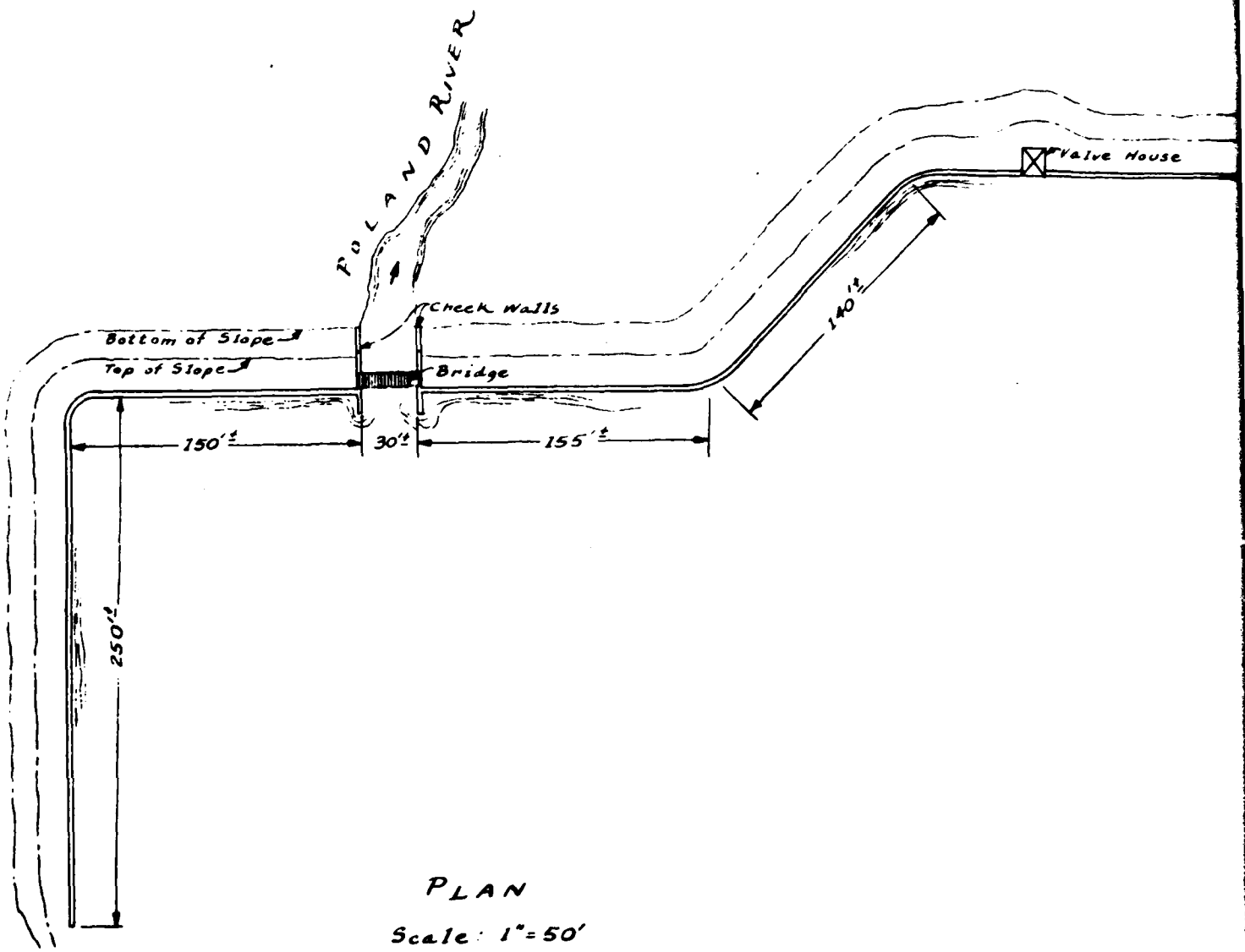
Respectfully submitted,

S. E. MINOR & CO., INC.

Edward F. Ahneman, Jr., P.E.
Chief Engineer

EFA:lb
Enclosure

Fig. D



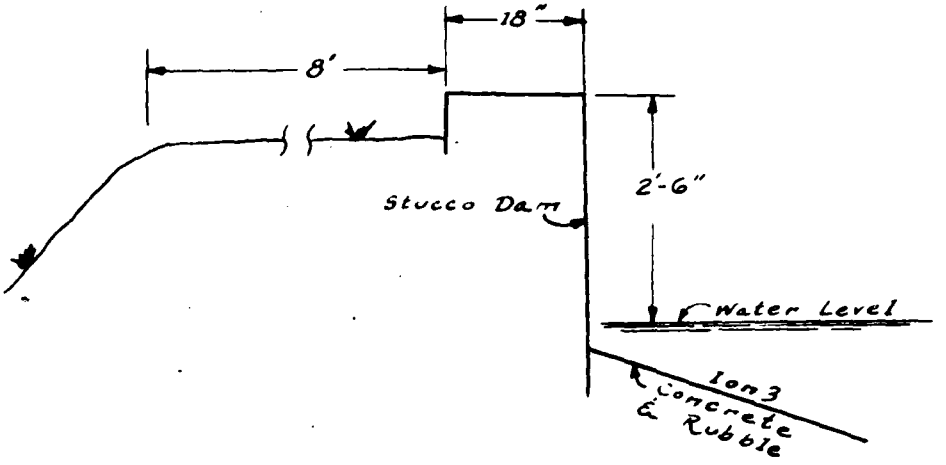
PLAN

Scale: 1"=50'

MINOR & CO., INC. CIVIL ENGINEERS
NWICH, CONN. June 4, 1975

SCALE As Noted

Valve House



SECTION
Scale 3/4" = 1'

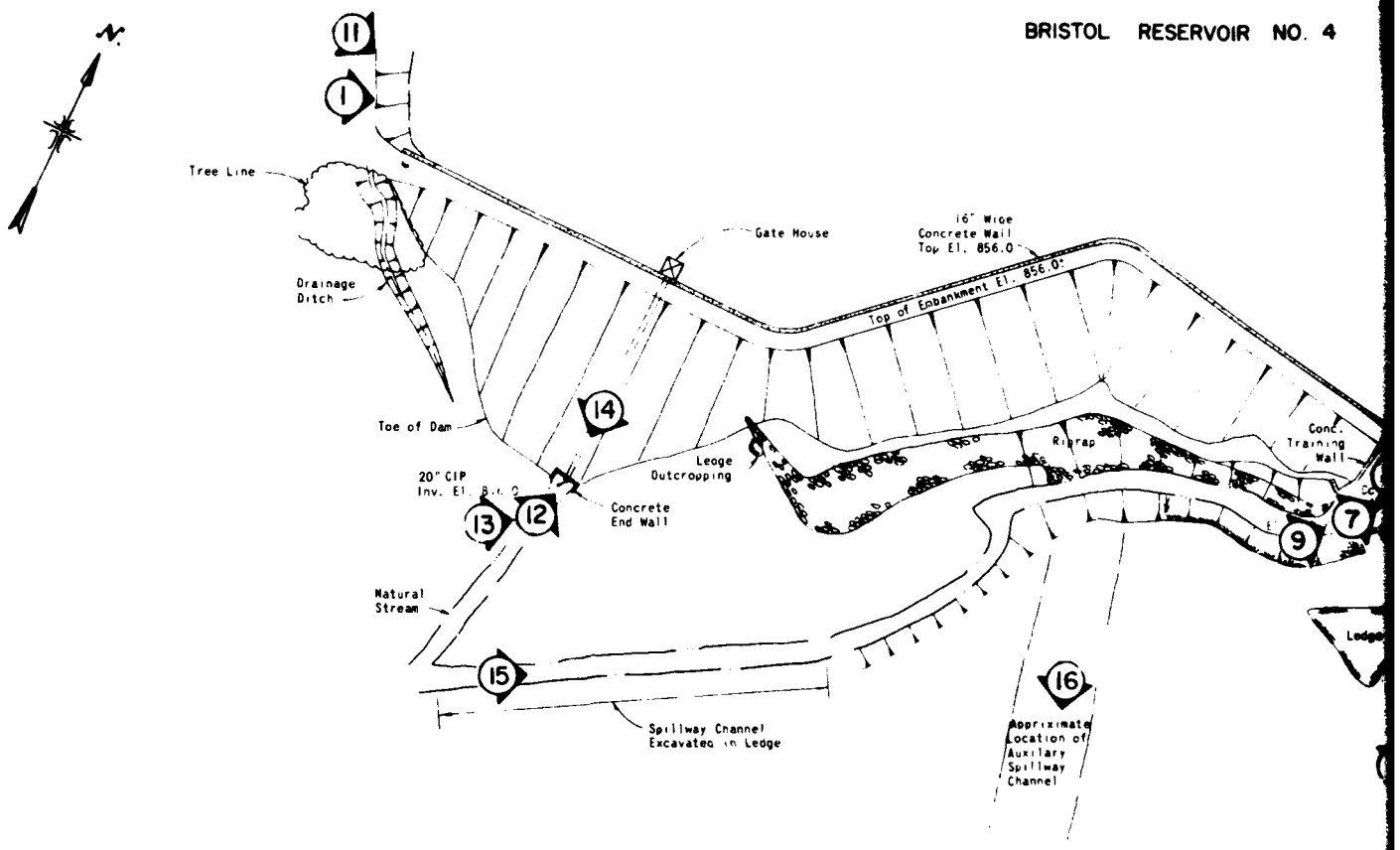
NOT TO SCALE

SKETCH
BRISTOL RESERVOIR # 4
HARWINTON, CONN.

APPENDIX C

PHOTOGRAPHS

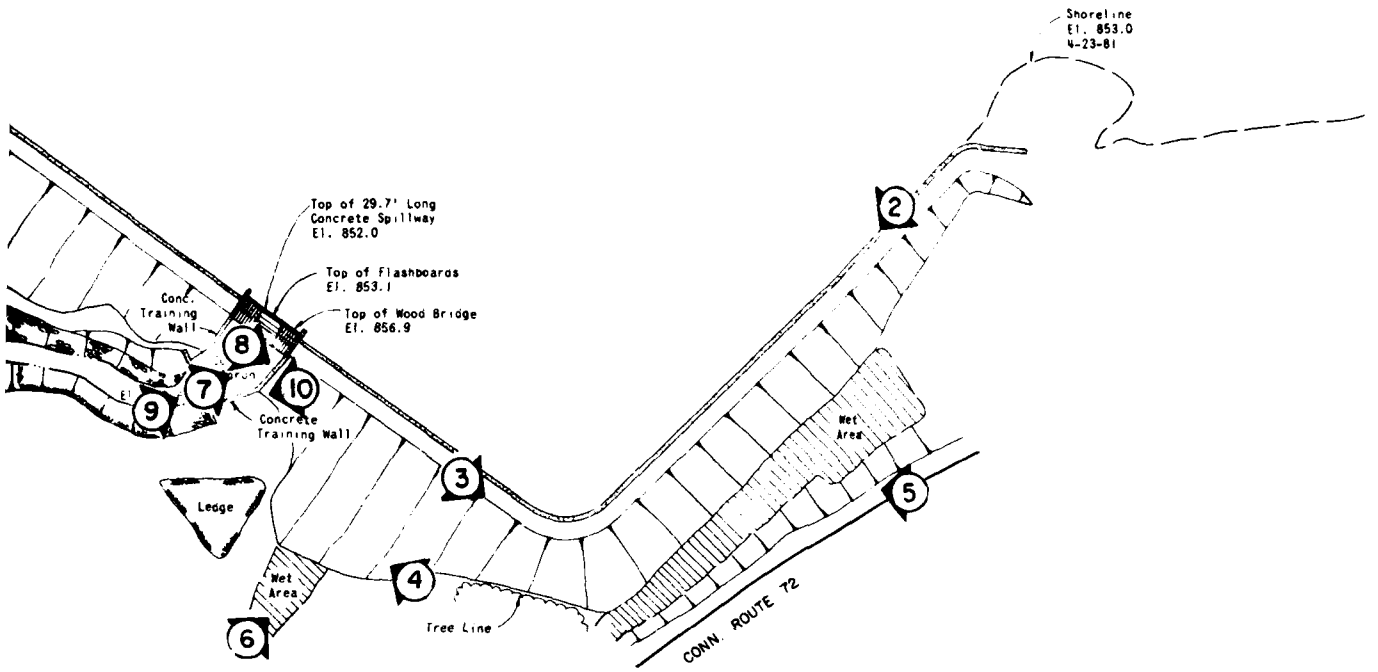
BRISTOL RESERVOIR NO. 4



Denotes photo number and direction in which photo was taken

FIGURE 3

ESERVOIR NO. 4



ROALD HAESTAD, INC CONSULTING ENGINEERS WATERBURY, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PHOTO LOCATION PLAN
BRISTOL RESERVOIR NO. 4 DAM
HARWINTON, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALES	PAGE
JRS	RGL	RH	DATE 5/81	C-1

PHOTO NO. 1

OVERVIEW OF UPSTREAM FACE OF DAM
FROM RIGHT ABUTMENT.

PHOTO NO. 2

RIPRAP SLOPE PROTECTION AND CONCRETE
FACING AT UPSTREAM SLOPE OF DAM.

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

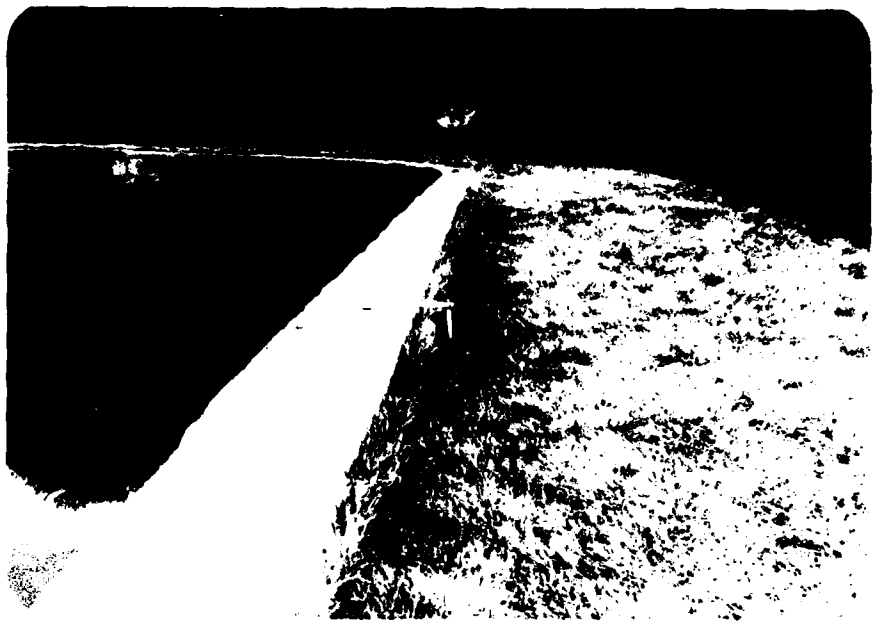


PHOTO NO. 3

UPSTREAM CONCRETE WALL AND CREST.
NOTE POSSIBLE SETTLEMENT OF EMBANKMENT
AND GRASS COVER ON CREST.

PHOTO NO. 4

ANIMAL BURROW ON DOWNSTREAM SLOPE AND CUT TREES AT THE TOE.

U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 28 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 5

WET AREA BETWEEN DAM AND ROUTE 72.

PHOTO NO. 6

DOWNSTREAM SEEPAGE. NOTE RUST-COLORED FLOCCULES.

U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 28 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

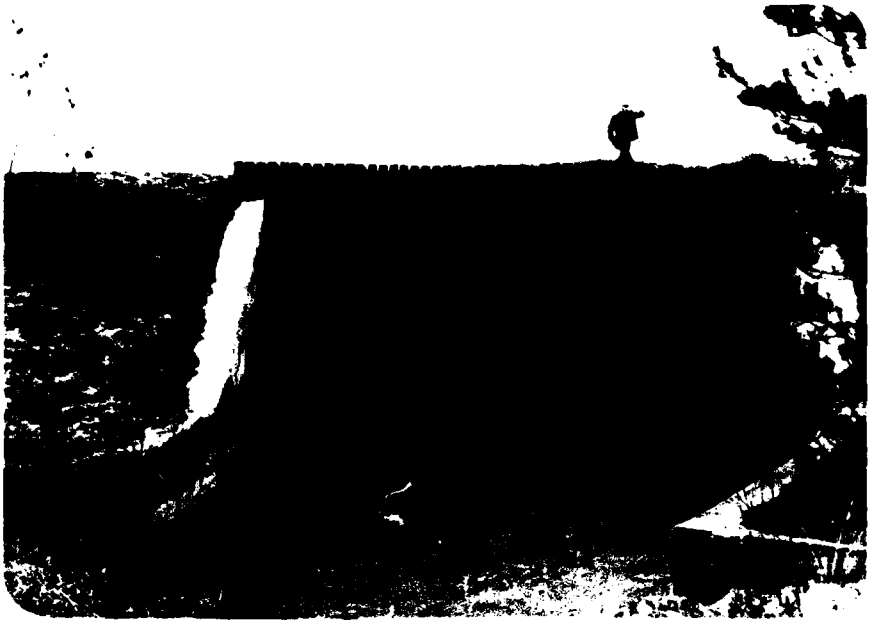


PHOTO NO. 7

SPILLWAY AND SERVICE BRIDGE FROM DOWNSTREAM.

PHOTO NO. 8

BASE OF LEFT TRAINING WALL.
NOTE SEPARATION OF GUNITE.

U.S ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 28 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 9

END OF SPILLWAY APRON. NOTE UNDERMINING.

PHOTO NO. 10

SPILLWAY DISCHARGE CHANNEL. NOTE LEDGE TO LEFT AND RIPRAP PLACED ALONG RIGHT SIDE OF CHANNEL TO PROTECT DOWNSTREAM TOE.

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 28 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

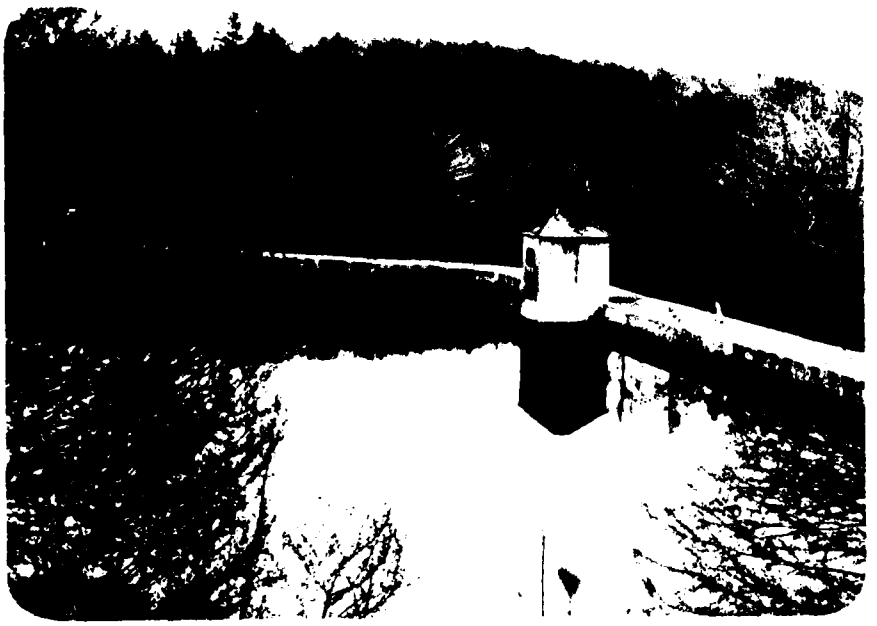


PHOTO NO. 11

GATEHOUSE

PHOTO NO. 12

ENDWALL AT DISCHARGE END OF OUTLET WORKS. NOTE DETERIORATION OF CONCRETE.

U.S ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 28 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 13

POSSIBLE SEEP IN STREAM BELOW OUTLET WORKS. NOTE RUST-COLORED FLOCCULES.

PHOTO NO. 14

NATURAL STREAM BELOW OUTLET WORKS. SPILLWAY CHANNEL ENTERS AT LEFT IN BACKGROUND.

U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 28 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 15

SPILLWAY CHANNEL EXCAVATED IN LEDGE.

PHOTO NO. 16

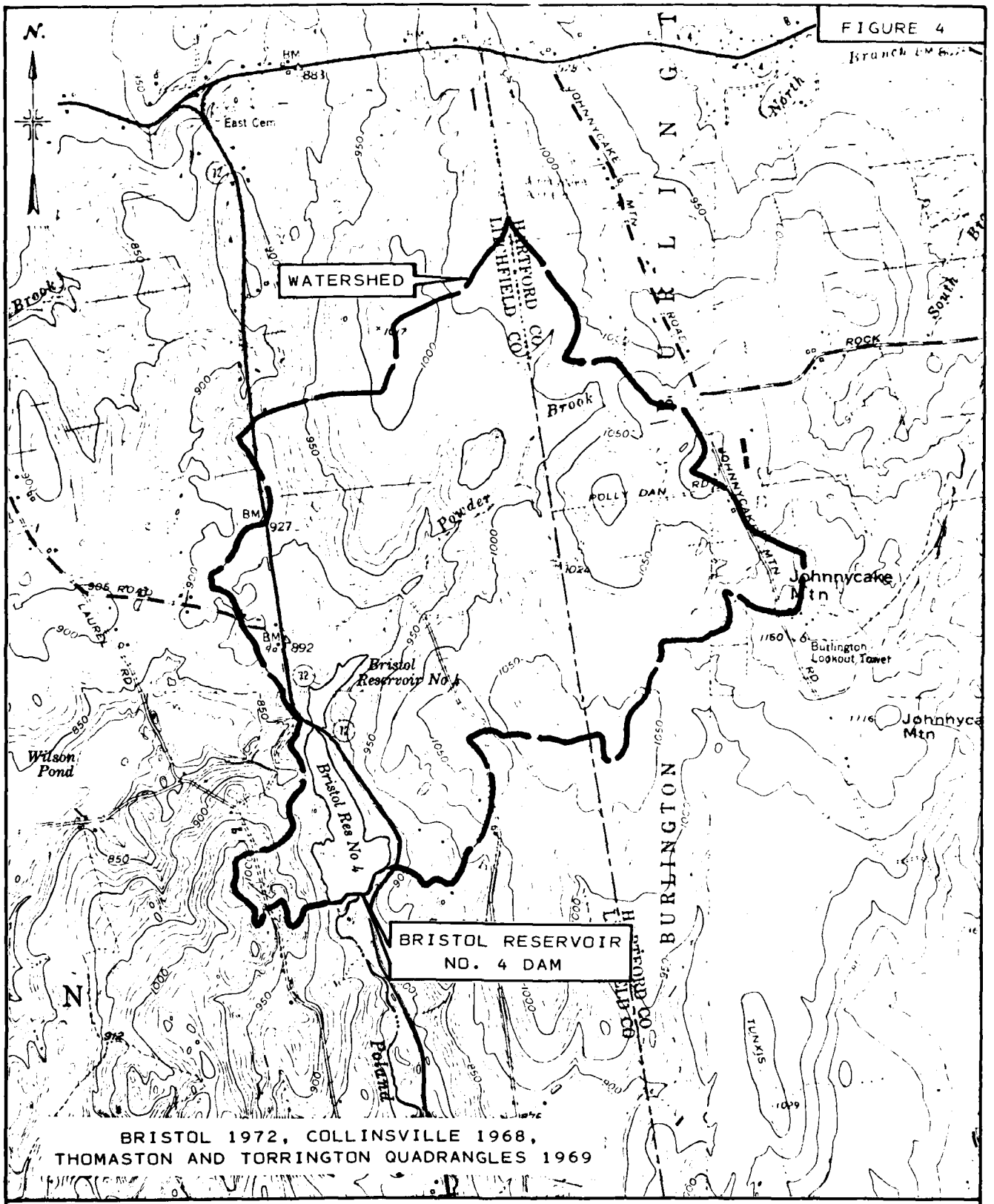
AUXILIARY SPILLWAY CHANNEL.
NOTE TREES AND BRUSH.

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	BRISTOL RES. NO. 4 DAM POLAND RIVER HARWINTON, CONNECTICUT CT 00364 28 APRIL '81
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

FIGURE 4



BRISTOL 1972, COLLINSVILLE 1968,
THOMASTON AND TORRINGTON QUADRANGLES 1969

WATERSHED MAP

BRISTOL RESERVOIR NO. 4 DAM
HARWINTON, CONNECTICUT

ROALD HAESTAD, INC.

SCALE: 1" = 2000'

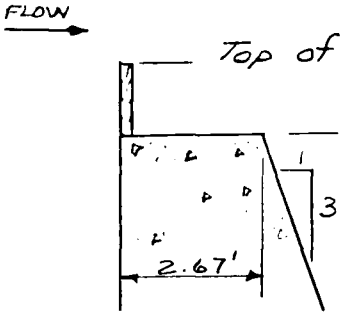
BY SAL DATE 5/26/81 **ROALD HAESTAD, INC.** SHEET NO 1 OF 5

CONSULTING ENGINEERS

CKD BY DLS DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-045

SUBJECT BRISTOL RESERVOIR NO. 4 - Project discharge capacity

Spillway Profile: (Not to scale)



$Q = CLH^{3/2}$

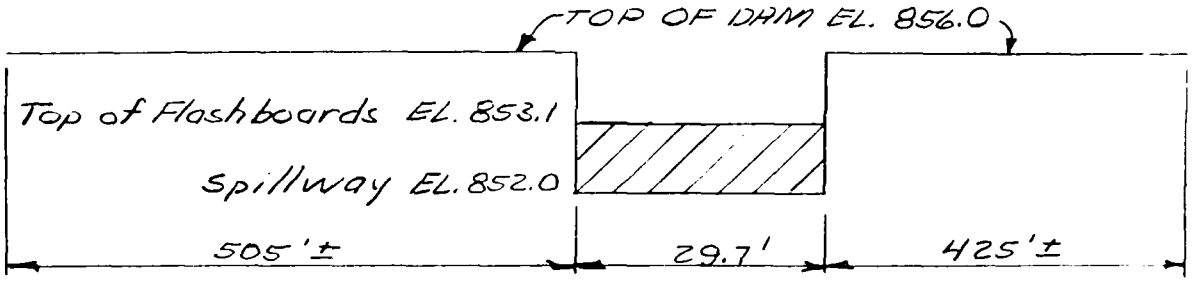
Spillway Length = 29.7'

Spillway discharge coeff. = 3.2

Flashboards " " = 3.3

Note: The bridge's influence on the spillway discharge capacity was not considered.

Dam Profile: (Not to Scale)



Dam Discharge coeff. = 3.0

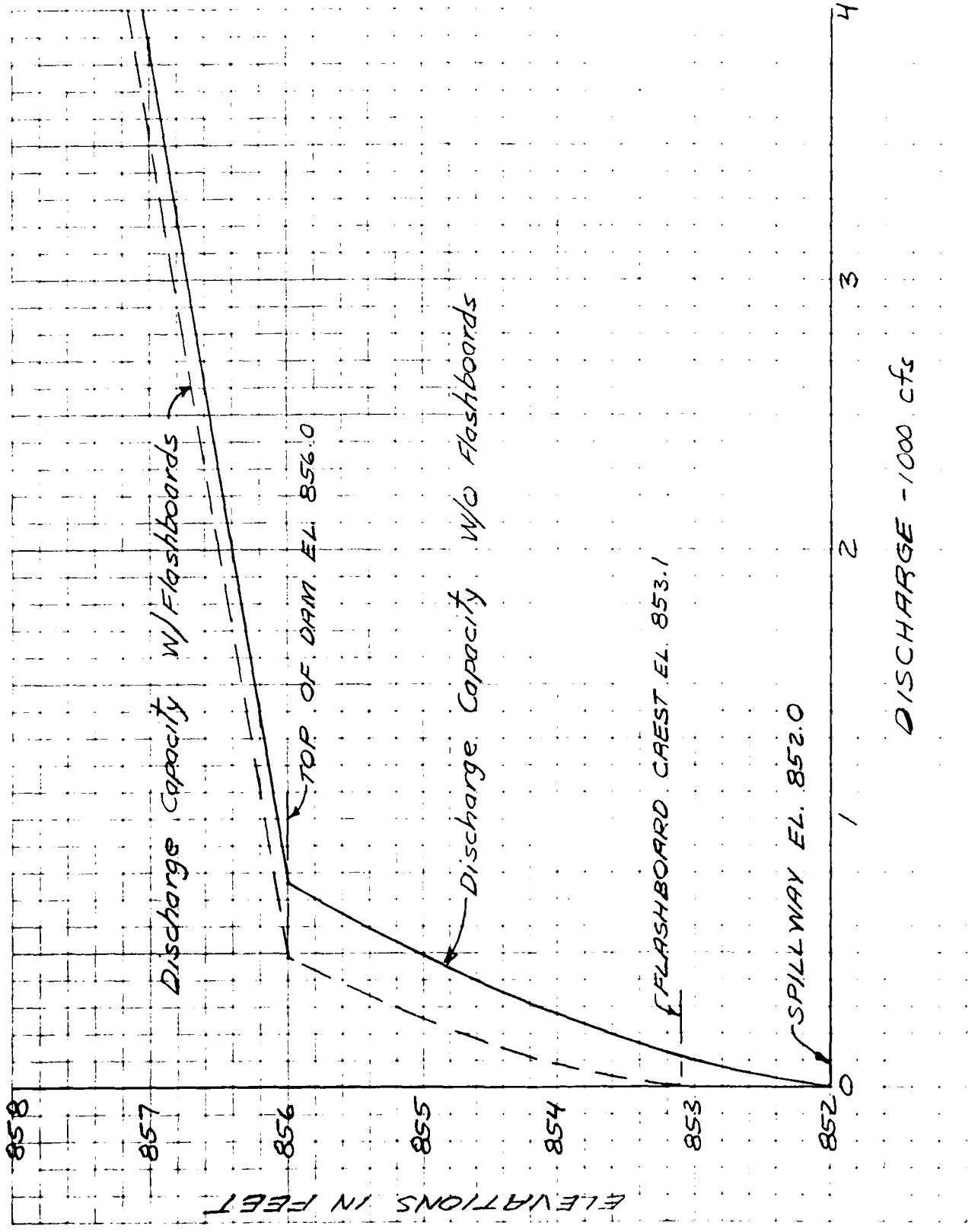
	W/O FLASHBOARDS			W/FLASHBOARDS		
ELEV. (feet)	Spillway (cfs)	Dam (cfs)	Total Disch. Cap. -(cfs)	Spillway (cfs)	Dam (cfs)	Total Disch. Cap. -(cfs)
852	0	0	0	0	0	0
853.1	110	0	110	0	0	0
854	269	0	269	84	0	84
855	494	0	494	257	0	257
856	760	0	760	484	0	484
857	1,063	2,790	3,853	755	2,790	3,545
858	1,397	7,891	9,288	1,063	7,891	8,954
859	1,760	14,497	16,257	1,405	14,497	15,902

BY SAL DATE 5/26/81 **ROALD HAESTAD, INC.** SHEET NO 2 OF 5

CONSULTING ENGINEERS

CKD BY DLS DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 110-045

SUBJECT BRISTOL RESERVOIR NO. 4 - Project discharge capacity curve



BY SAL DATE 5/14/81 **ROALD HAESTAD, INC.** SHEET NO 2 OF 5

CONSULTING ENGINEERS

CKD BY DL DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-045

SUBJECT BRISTOL RESERVOIR NO. 4 - Surcharge storage capacity

ELEV. (feet)	Surface Area (Acres)	Average Surface Area (Acres)	Surcharge Storage Capacity (Acre-Feet)	
			W/o Flashboards	W/Flashboards
852	43 *		0	0
		44		
853.1	45		48	0
		45.8		
854	46.6		90	41
		47.45		
855	48.3		137	89
		49.2		
856	50.1		186	138
		51.0		
857	51.9		237	189
		52.8		
858	53.7		290	242
		54.55		
859	55.4		345	296
		56.3		
860	57.2		401	353

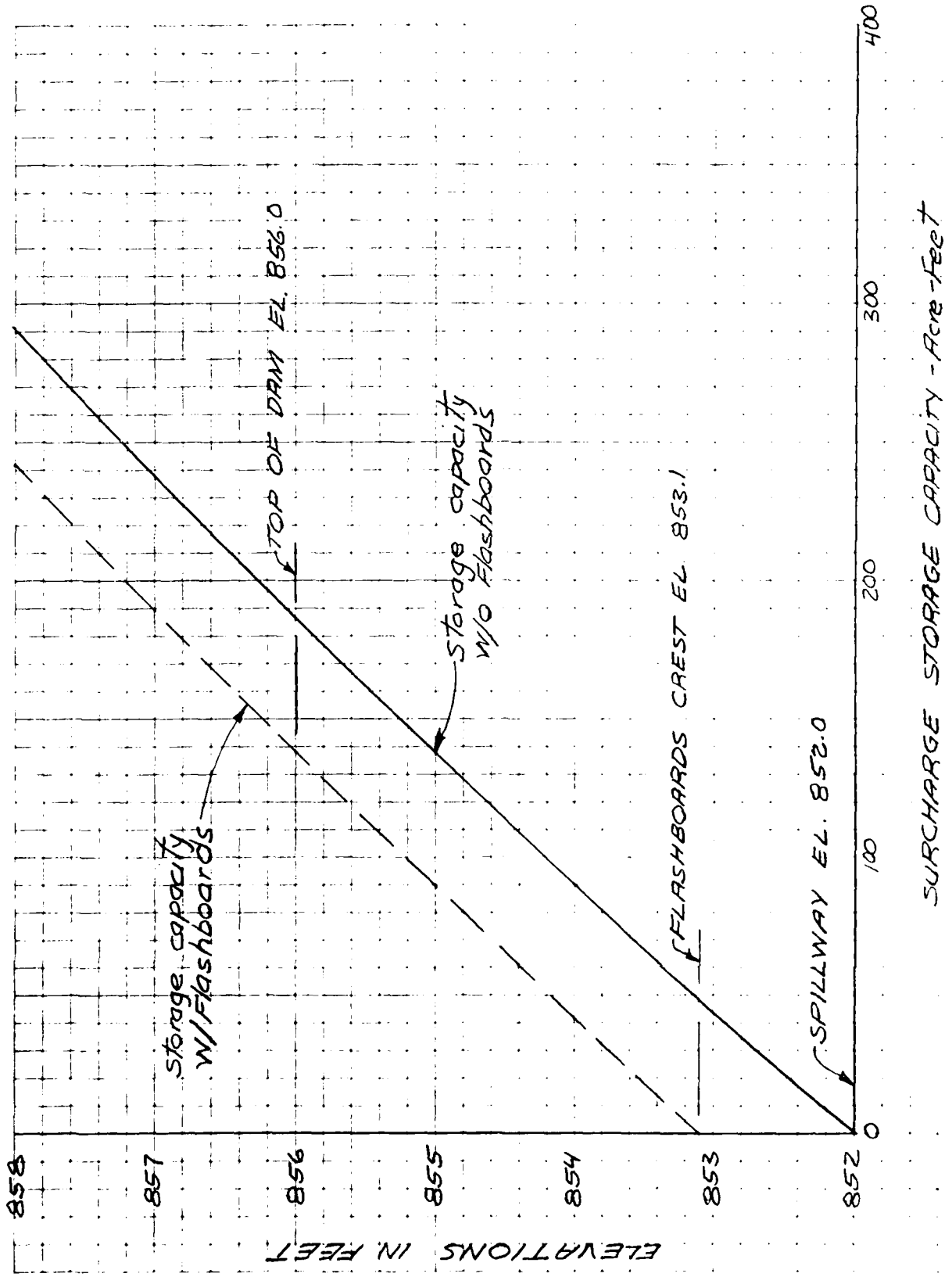
* The surface area at spillway level was supplied by the Bristol Water Department.

BY SAL DATE 5/26/81 **ROALD HAESTAD, INC.** SHEET NO 4 OF 7

CONSULTING ENGINEERS

CKD BY VLS DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 419-045

SUBJECT BRISTOL RESERVOIR NO. 4 - Surcharge storage capacity curve



BY SAL DATE 5/26/81 **ROALD HAESTAD, INC.** SHEET NO 5 OF 5
CONSULTING ENGINEERS
CKD BY DHS DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 81-045
SUBJECT BRISTOL RESERVOIR NO. 4 - Test Flood

TEST FLOOD = ½ PMF

Drainage Area = 1,107 Acres = 1.73 sq. mi.

From Corps of Engineers chart for "ROLLING" Terrain

MPF = 2,125 cfs/sq mi (2.0 sq.mi Minimum)

PMF = 2,125 cfs/sq.mi × 1.73 sq. mi = 3,676 cfs

½ PMF = ½ (3676) = 1,838 use 1,840 cfs

Q_{P1} = 1,840 cfs

Note: The flood routing for the test flood was done assuming no flashboards are in place.

H_1 = 4.4 feet above spillway, from Discharge Capacity Curve

$STOR_1$ = 206 Ac-Ft, from Storage Capacity Curve

= 2.2" of runoff from 1.73 sq. mi.

Note: PMF runoff in New England equals approx. 19".

Therefore ½ PMF runoff equals approx. ½(19) = 9.5".

$Q_{P2} = Q_{P1}(1 - STOR_1/9.5") = 1,840 cfs (1 - 2.2/9.5) = 1,414$ cfs

H_2 = 4.2 ft $STOR_2$ = 196 Ac-Ft

$STOR_{AVE} = (STOR_1 + STOR_2)/2 = (206+196)/2 = 201$ Ac-Ft
= 2.2" of runoff

$Q_{P3} = Q_{P1}(1 - STOR_{AVE}/9.5) = 1,840 cfs (1 - 2.2/9.5) = 1,414$
use 1,410 cfs

Spillway capacity W/O Flashboards = 760 cfs
(Top of dam)

% of ½ PMF = (760/1410) × 100 = 54% of ½ PMF

Spillway W/Flashboards = 480 cfs (480/1410) × 100 = 34% of ½ PMF

BY SAL DATE 5/26/81 **ROALD HAESTAD, INC.** SHEET NO ..... OF .....

CONSULTING ENGINEERS

CKD BY DLS DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-045

SUBJECT BRISTOL RESERVOIR NO. 4 - Dam breach calculations

S = Storage at time of failure with water level at top of dam

S = Storage at Flashboard Level + Surcharge Storage

$$S = \left[263 \times 10^6 \text{ gal} \times \frac{1 \text{ acre-feet}}{325,851 \text{ gal}} \right]^{*} + 138 \text{ Ac-Ft (From surcharge storage capacity curve)}$$

$S = 807 \text{ Ac-Ft} + 138 \text{ Ac-Ft} = 945 \text{ Ac-Ft}$

* The storage capacity at flashboard level was supplied by the Bristol Water Department.

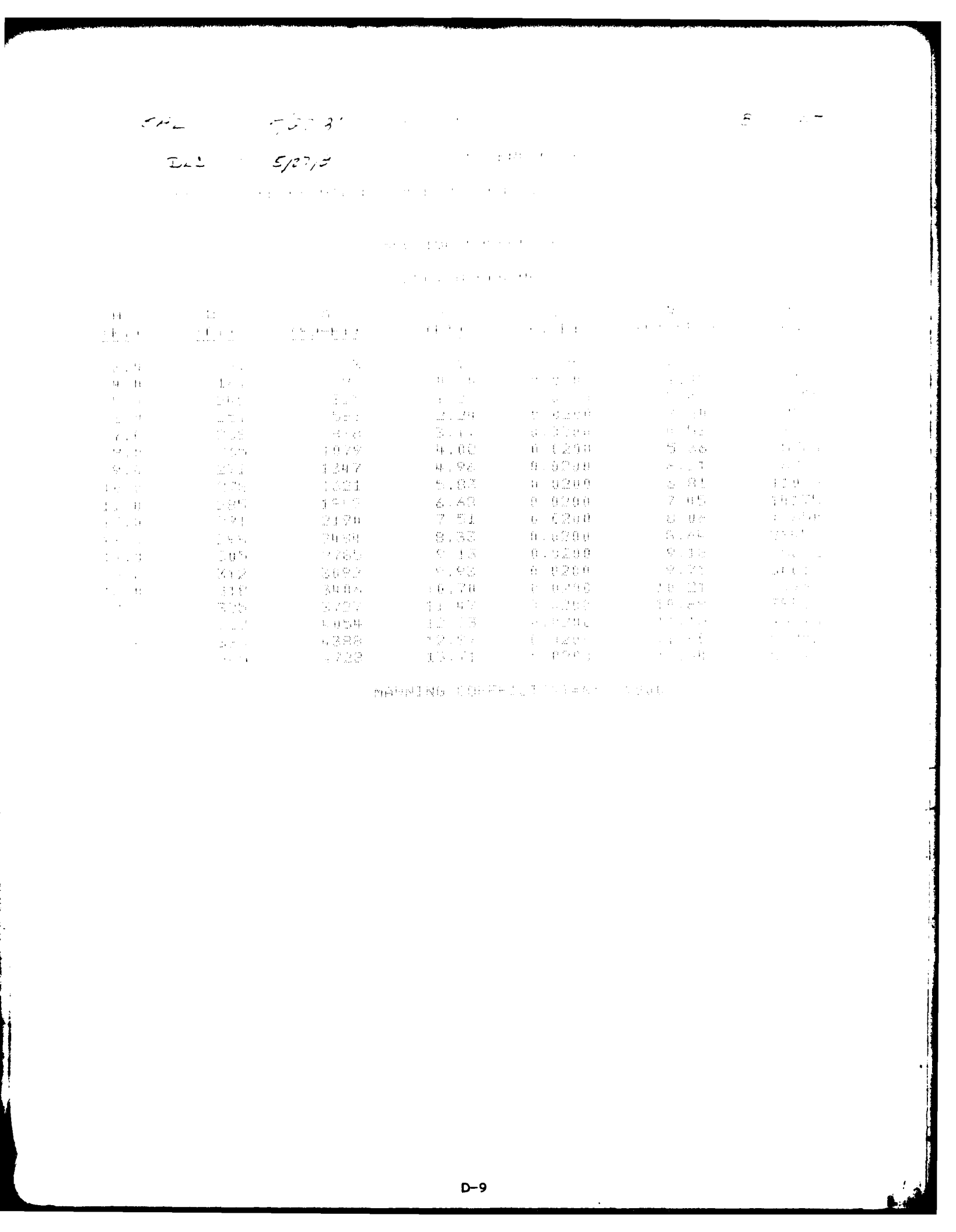
Q_{pl} = Peak Failure Outflow = $8/27\ W_b \sqrt{g}\ Y_o^{3/2}$

W_b = Breach width - 40 % of dam length across river at mid-height = 0.4(125) = 50'

Y_o = Total height from river bed to pool level at time of failure = 40'

$$Q_{pl} = 8/27\ (50)\sqrt{32.2}\ (40)^{3/2}$$

$$= 21,267 \text{ use } 21,300 \text{ cfs}$$



SEA LEVEL DOUBLET 11

FLIGHT DIVERGENT

M	U	Q	T	A	V	
7.0	76	44	4.44	0.0736	1.1	
8.0	110	124	4.5	0.0761	1.1	5.1
9.0	150	239	4.76	0.0719	1.1	10.1
10.0	197	413	4.99	0.0700	1.09	8.1
11.0	1e6	562	5.17	0.0700	1.12	1.1e6
12.0	17.	754	5.27	0.0200	1.13	5.15
13.0	185	934	5.34	0.0200	2.13	7.19
14.0	1e8	1124	5.39	0.0200	2.14	9.11
15.0	2e7	1322	6.51	0.0200	2.16	1.1e10
16.0	219	1530	7.21	0.0200	2.53	1.09e1
17.0	232	1746	7.96	0.0200	10.02	1.1e12
18.0	2e4	1979	8.40	0.0200	10.64	1.14e1
19.0	2e0	2212	9.02	0.0200	11.24	1.15e1
20.0	255	2467	9.37	0.0200	11.84	2e1.0

SAL [illegible]

DLS [illegible]

[illegible]

[illegible]

[illegible] SECTION

	A R E A (SQ.FT.)				D I S C H A R G E (CFS)			
H	A	B	C	TOTAL	A	B	C	TOTAL
[illegible]	12	0	0	[illegible]	66	0	0	66
[illegible]	27	0	0	[illegible]	15[illegible]	0	0	15[illegible]
[illegible]	43	3	0	[illegible]	20[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	61	[illegible]	0	[illegible]	[illegible]	45	[illegible]	[illegible]
[illegible]	81	315	0	[illegible]	[illegible]	[illegible]	0	1501
[illegible]	107	563	0	[illegible]	[illegible]	2026	0	[illegible]
7.0	139	910	44	1060	1847	3107	[illegible]	[illegible]
[illegible]	171	1079	130	[illegible]	[illegible]	5780	[illegible]	[illegible]
[illegible]	203	1347	264	[illegible]	[illegible]	8237	1011	[illegible]
10.0	235	[illegible]	419	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11.0	267	1902	592	2750	4387	14175	[illegible]	[illegible]
12.0	299	2190	758	3242	[illegible]	[illegible]	[illegible]	[illegible]
13.0	331	2484	934	[illegible]	6166	[illegible]	[illegible]	[illegible]
14.0	363	2785	1124	[illegible]	7192	[illegible]	[illegible]	[illegible]
15.0	395	3092	1320	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16.0	427	3406	1540	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17.0	459	3727	1746	[illegible]	10640	[illegible]	[illegible]	[illegible]
18.0	491	4054	1973	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19.0	523	4388	2212	[illegible]	13229	[illegible]	[illegible]	[illegible]
20.0	555	4726	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STORAGE AT TIME OF FAILURE= [illegible]
LENGTH OF REACH= [illegible]

INFLOW INTO REACH=QP1= [illegible]
DEPTH OF FLOW=H1= [illegible]
CROSS SECTIONAL AREA=A1= [illegible]
STORAGE IN REACH= [illegible]

TRIAL REACH OUTFLOW= [illegible]
TRIAL DEPTH OF FLOW= [illegible]
TRIAL CROSS SECTIONAL AREA= [illegible]
TRIAL STORAGE IN REACH= [illegible]

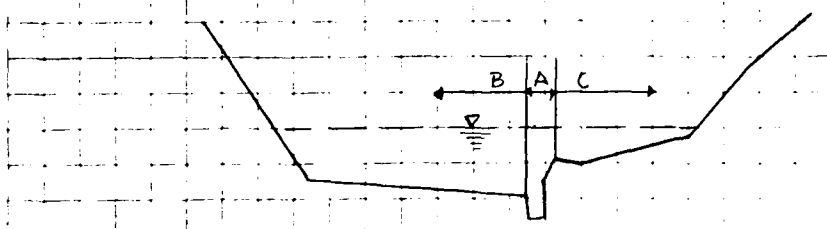
REACH OUTFLOW= [illegible]
DEPTH OF FLOW= [illegible]

BY RAV DATE 5-26-81 **ROALD HAESTAD, INC.** SHEET NO 1 OF 5

CKD BY SAL DATE 5-27-81 CONSULTING ENGINEERS 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-045

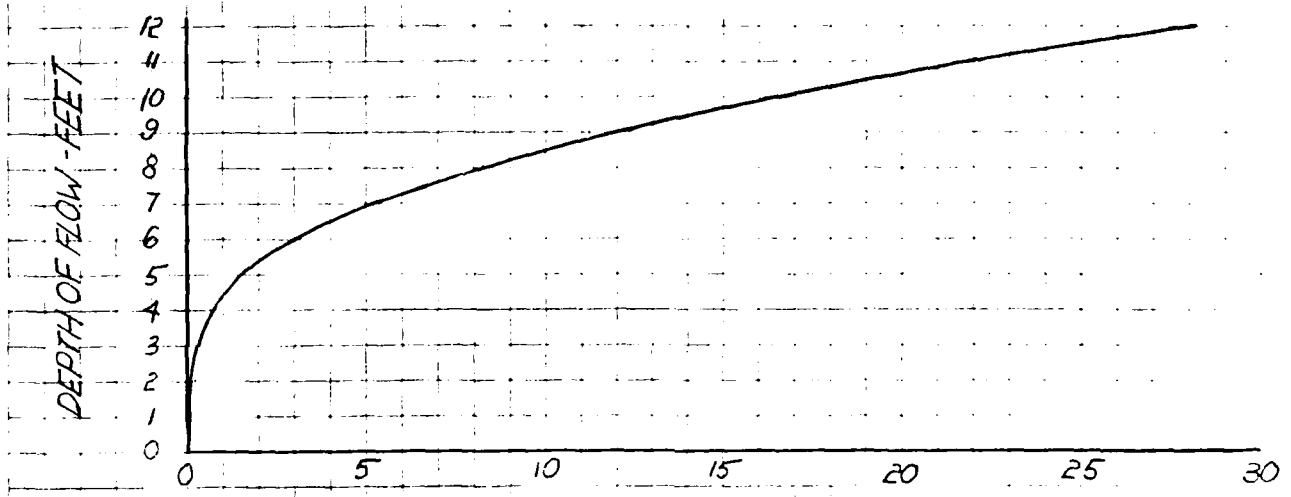
SUBJECT BRISTOL RESERVOIR NO 4 - FLOOD ROUTING

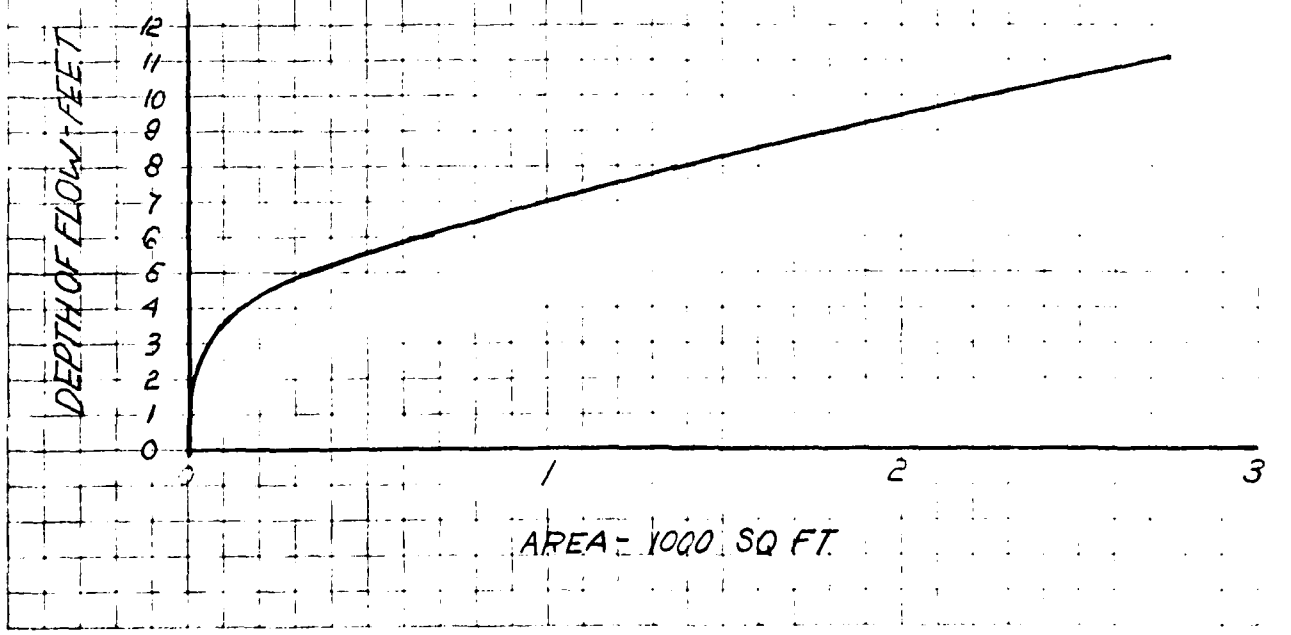
SECTION NO 1



SCALE:
1" = 200' HORZ
1" = 20' VERT

L = 2000'
S = 0.02
N(A) = 0.05
N(B) = 0.1
N(C) = 0.08





EHL 5/27/81

DLS 5/27/81

SECTION NUMBER 2

TOTAL SECTION
STORAGE CAPACITY WITHIN REACH

HEIGHT (FEET)	SURFACE AREA (ACRES)	STORAGE VOLUME (ACRE FEET)
1.0	0.15	0
2.0	0.29	0
3.0	0.45	0
4.0	0.60	1
5.0	0.75	1
6.0	0.90	2
7.0	1.05	3
8.0	1.20	4
9.0	1.35	5
10.0	1.50	7
11.0	3.42	9
12.0	5.16	14
13.0	6.99	20
14.0	8.82	28
15.0	10.65	37
16.0	12.48	49
17.0	14.31	62
18.0	16.14	78
19.0	17.97	96
20.0	19.98	116
21.0	21.99	138
22.0	23.00	162
23.0	23.70	187
24.0	25.00	213
25.0	26.30	240

STORAGE CAPACITY CALCULATED FROM SURFACE AREAS AT LOWER LEVEL

SAL 5/27/81

DLS 5/27/81

SECTION 2

RISER SECTION

HEIGHT ABOVE INVERT (FEET)	D I S C H A R G E		
	CONDUIT (CFS)	SPILLWAY (CFS)	
1.0	25	0	
2.0	47	0	47
3.0	64	0	64
4.0	140	0	140
5.0	192	0	192
6.0	235	0	235
7.0	264	0	264
8.0	323	0	323
9.0	354	0	354
10.0	365	538	903
11.0	410	952	1362
12.0	438	1350	1788
13.0	462	2220	2682
14.0	480	3210	3690
15.0	511	4317	4828
16.0	542	5542	6084
17.0	569	12941	13510
18.0	587	16382	16969
19.0	591	20783	21374
20.0	616	25547	26163
21.0	629	31674	32303
22.0	640	38164	38804
23.0	658	44897	45555
24.0	672	52914	53586
25.0	686	61252	61938

STORAGE AT TIME OF FAILURE= 0. AC FT
LENGTH OF STORM= 0.00 HR

INFLOW INTO REACH= 0.00 CFS
HEIGHT ABOVE CONDUIT INVERT= 0.00 FT
STORAGE IN REACH= 0.00 AC FT

TRIAL REACH OUTFLOW=OUTFLOW= 0.00 CFS
TRIAL HEIGHT ABOVE CONDUIT INVERT=H(I)TRIAL= 0.00 FT
TRIAL STORAGE IN REACH=V(I)TRIAL= 0.00 AC FT

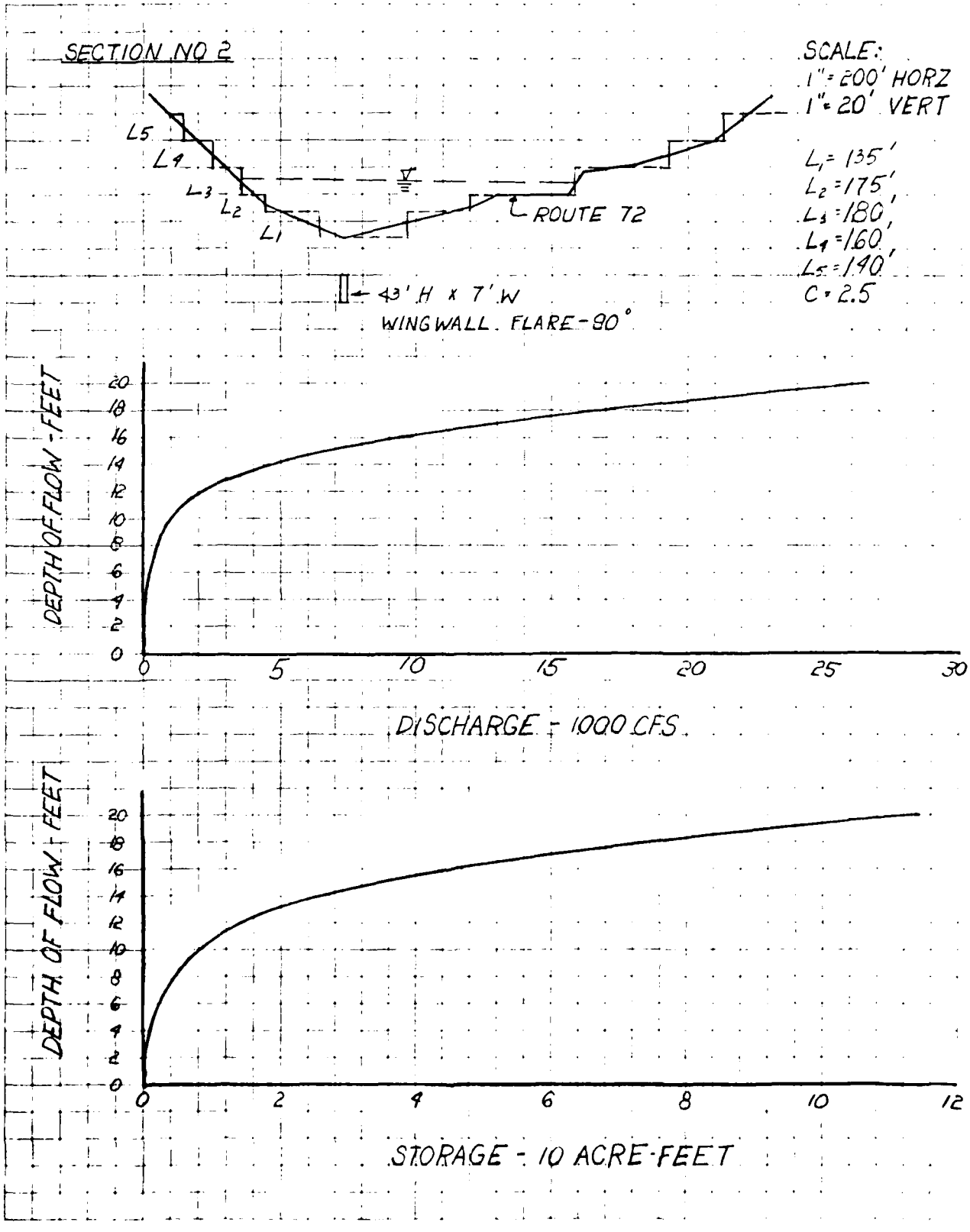
REACH OUTFLOW= 0.00 CFS
HEIGHT ABOVE CONDUIT INVERT= 0.00 FT

BY DAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 4 OF 7

CONSULTING ENGINEERS

CKD BY SHL DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-045

SUBJECT BRISTOL RESERVOIR NO 4 - FLOOD ROUTING



SHL 5/27/81

DLS 5/27/81

TRIAL SECTION

H (FT)	M (FT)	A (SQ FT)	R (FT)	S (FT/FT)	V (FT/SEC)	Q (CFS)
1.0	50	25	0.50	0.0077	5.87	[illegible]
2.0	100	100	1.00	0.0077	7.50	[illegible]
3.0	150	225	1.50	0.0077	[illegible]	[illegible]
4.0	200	400	[illegible]	0.0077	[illegible]	[illegible]
5.0	250	625	2.50	0.0077	[illegible]	[illegible]
6.0	300	900	3.00	0.0077	[illegible]	[illegible]
7.0	350	1225	3.50	0.0077	[illegible]	[illegible]
8.0	400	1600	4.00	0.0077	[illegible]	[illegible]
9.0	450	2025	4.50	0.0077	[illegible]	[illegible]
10.0	500	2500	5.00	0.0077	[illegible]	[illegible]
11.0	519	3025	[illegible]	0.0077	[illegible]	[illegible]
12.0	536	3600	[illegible]	0.0077	[illegible]	[illegible]
13.0	553	4225	[illegible]	0.0077	[illegible]	[illegible]
14.0	571	4900	8.13	0.0077	[illegible]	[illegible]
15.0	589	5625	[illegible]	0.0077	[illegible]	[illegible]
16.0	606	6400	[illegible]	0.0077	[illegible]	[illegible]
17.0	624	7225	[illegible]	0.0077	[illegible]	[illegible]
18.0	642	8100	[illegible]	0.0077	[illegible]	[illegible]
19.0	659	9025	[illegible]	0.0077	[illegible]	[illegible]
20.0	677	10000	[illegible]	0.0077	[illegible]	[illegible]
21.0	689	[illegible]	[illegible]	0.0077	[illegible]	[illegible]
22.0	702	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23.0	715	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24.0	727	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25.0	740	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

MANNING COEFFICIENT=[illegible]

[illegible]

[illegible]

TRIAL FLOW QUANTITY=[illegible]

TRIAL DEPTH OF FLOW=[illegible]

TRIAL CROSS SECTIONAL AREA=[illegible]

TRIAL VELOCITY=[illegible]

[illegible]

DEPTH OF FLOW=[illegible]

BY PAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO ... OF ...

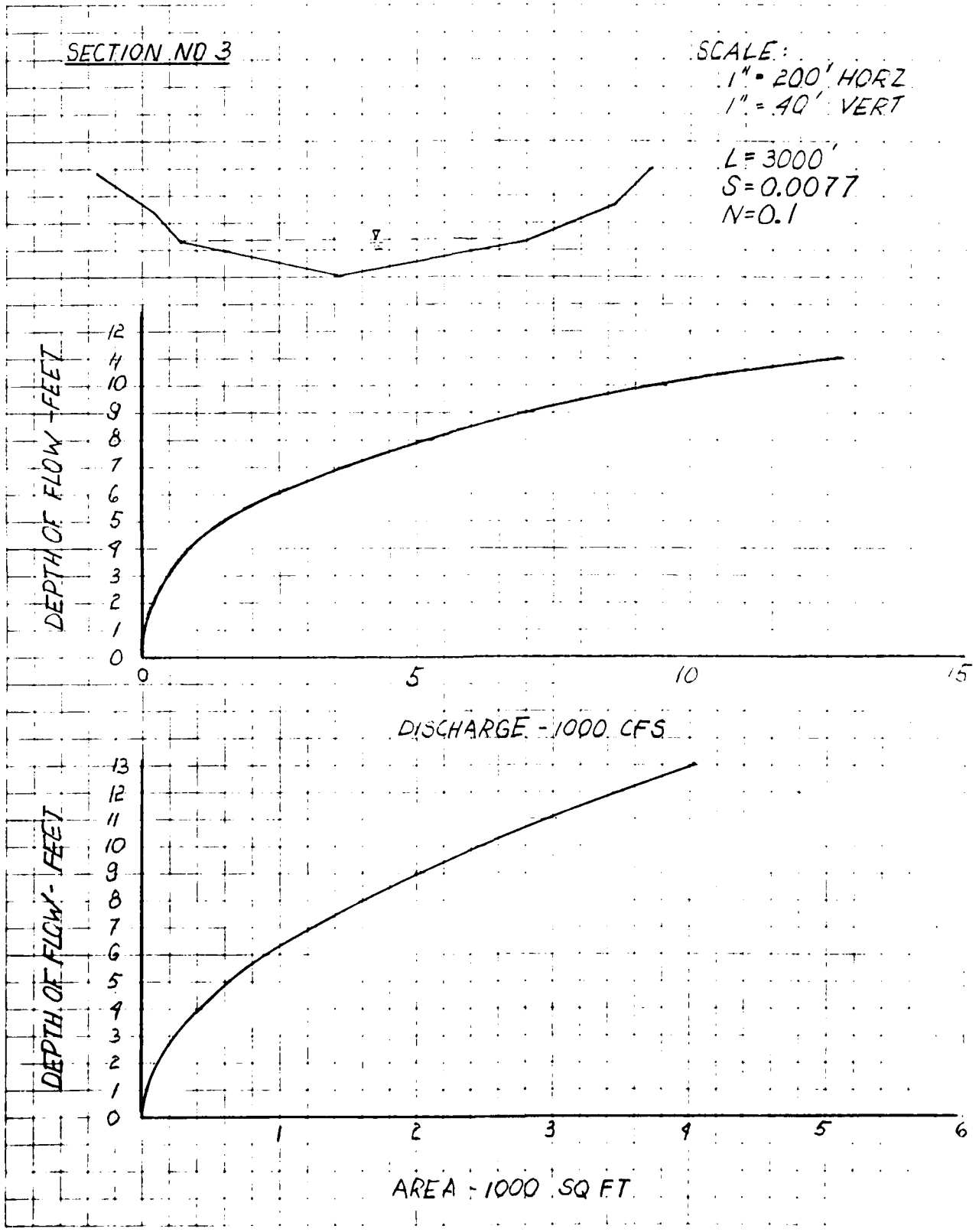
CKD BY SAL DATE 5/27/81 CONSULTING ENGINEERS 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-045

SUBJECT BRISTOL RESERVOIR NO. 4 - FLOOD ROUTING

SECTION NO 3

SCALE:
1" = 200' HORZ
1" = 40' VERT

L = 3000'
S = 0.0077
N = 0.1



SAL 5/27/81

DLS 5/27/81

H (FT)	W (FT)	P (SQ-FT)	P (FT)	S (FT/FT)	V (FT/SEC)	Q (CFS)
1.0	28	14	0.50	0.0067	0.72	10
2.0	55	55	1.00	0.0067	1.21	67
3.0	83	124	1.50	0.0067	1.58	196
4.0	110	220	1.99	0.0067	1.92	422
5.0	138	344	2.49	0.0067	2.20	757
6.0	165	495	2.99	0.0067	2.46	1218
7.0	193	674	3.49	0.0067	2.69	1813
8.0	221	880	3.98	0.0067	2.91	2561
9.0	248	1114	4.48	0.0067	3.11	3472
10.0	276	1375	4.98	0.0067	3.30	4559
11.0	296	1660	5.61	0.0067	3.48	5834
12.0	316	1965	6.22	0.0067	3.64	7309
13.0	336	2290	6.81	0.0067	3.80	8994
14.0	356	2635	7.40	0.0067	3.95	10902
15.0	376	3000	7.97	0.0067	4.09	13043
16.0	396	3385	8.54	0.0067	4.23	15429
17.0	416	3790	9.10	0.0067	4.36	18071
18.0	437	4215	9.65	0.0067	4.49	20980
19.0	457	4660	10.20	0.0067	4.62	24168
20.0	477	5125	10.75	0.0067	4.74	27646
21.0	494	5609	11.30	0.0067	4.86	31426
22.0	512	6119	11.85	0.0067	4.97	35519
23.0	530	6629	12.39	0.0067	5.08	39936
24.0	547	7165	13.00	0.0067	5.19	44688
25.0	565	7719	13.66	0.0067	5.29	49787

MANNING COEFFICIENT=(N)=0.1000

STORAGE AT TIME OF FAILURE=S= [illegible] AC-FT.

LENGTH OF REACH=L= [illegible] FT

INFLOW INTO REACH=QI= [illegible] CFS

DEPTH OF FLOW=H= [illegible] FT.

CROSS SECTIONAL AREA=A= [illegible] SQ FT

STORAGE IN REACH=V= [illegible] AC-FT.

TRIAL REACH OUTFLOW=QO=(TRIAL)= 3,400 CFS

TRIAL DEPTH OF FLOW=H(TRIAL)= 15.2 FT

TRIAL CROSS SECTIONAL AREA=A(TRIAL)= [illegible] SQ FT.

TRIAL STORAGE IN REACH=V(TRIAL)= [illegible] AC. FT

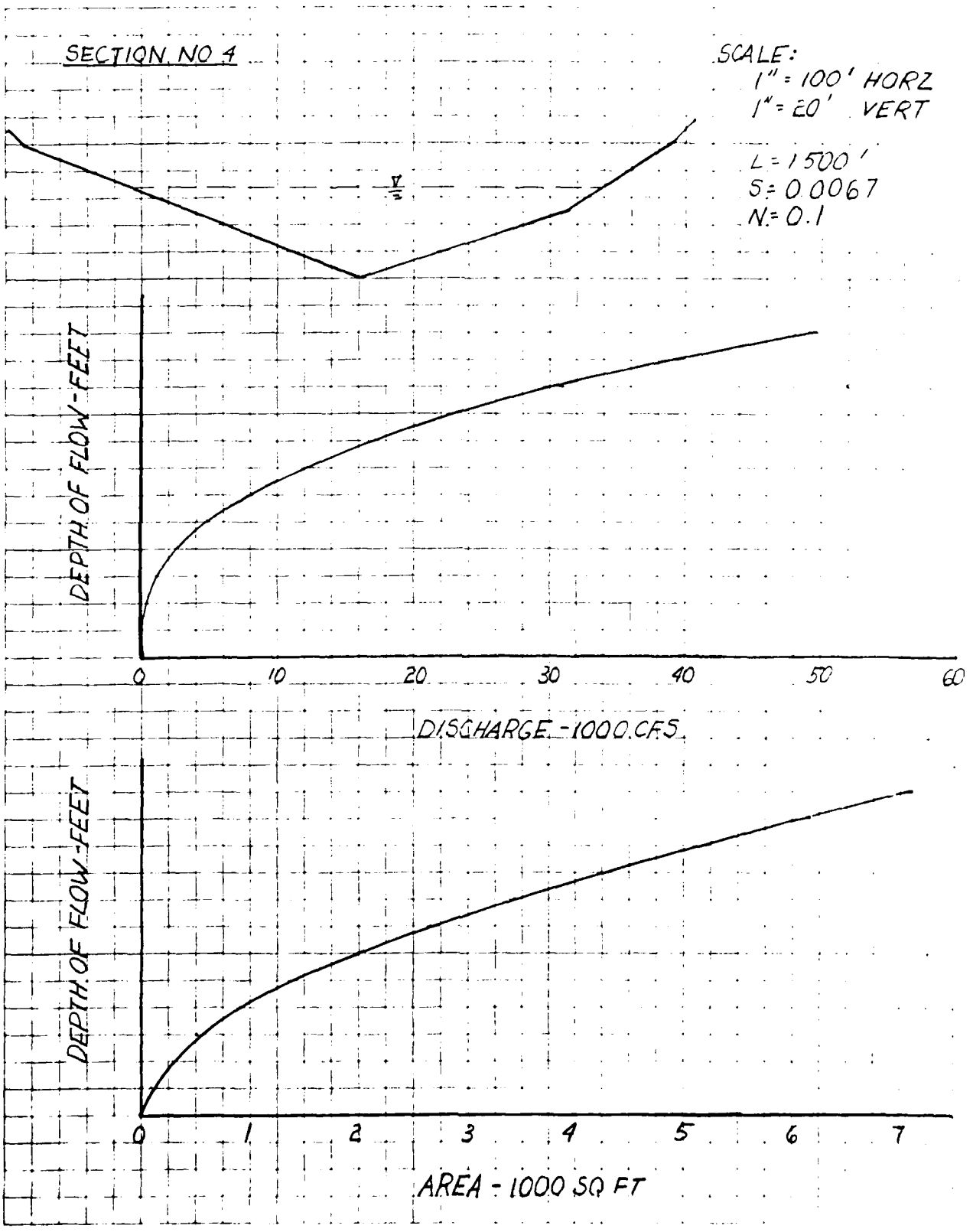
REACH OUTFLOW=QO= 3,400 CFS

DEPTH OF FLOW=H= 15.2 FT.

BY PAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 5 OF .....

CKD BY SAL DATE 5/22/81 CONSULTING ENGINEERS 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 045-045

SUBJECT BRISTOL RESERVOIR NO. 4 - FLOOD ROUTING



EAL 5/27/81

DLS 5/27/81

[illegible]

[illegible]

[illegible]

H (FT)	U (FT)	A (SQ-FT)	R (FT)	S (FT/FT)	V (FT/SEC)	Fr
1.6	18	9	0.56	0.0160	3.[illegible]	1.[illegible]
2.9	35	35	0.99	0.0160	[illegible]	[illegible]
3.6	53	74	1.49	0.0150	[illegible]	[illegible]
4.0	71	140	1.98	0.0160	[illegible]	[illegible]
5.9	88	215	2.48	0.0160	[illegible]	[illegible]
6.9	106	311	2.98	0.0160	[illegible]	[illegible]
7.9	124	429	3.47	0.0150	[illegible]	[illegible]
8.9	141	560	3.97	0.0160	[illegible]	[illegible]
9.9	159	709	4.46	0.0160	[illegible]	[illegible]
10.9	176	875	4.96	0.0160	[illegible]	[illegible]
11.9	186	1035	5.66	0.0160	[illegible]	[illegible]
12.9	196	1245	6.34	0.0160	[illegible]	[illegible]
13.9	207	1445	7.00	0.0160	[illegible]	[illegible]
14.9	217	1655	7.64	0.0160	[illegible]	[illegible]
15.9	227	1870	8.27	0.0150	[illegible]	[illegible]

MANNING COEFFICIENT=N= [illegible]

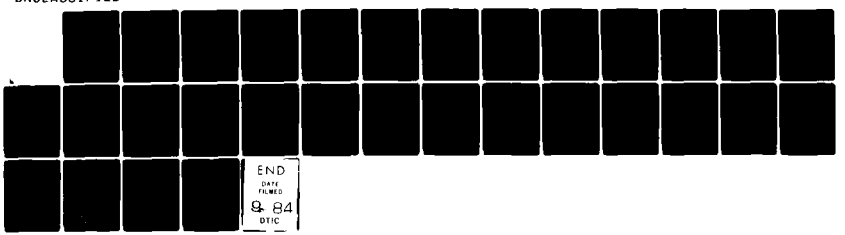
SHL 5/27/81

DLC 5/27/81

H (FT)	W (FT)	A (SQ-FT)	P (FT)	R (FT/FT)	V (FPS)	T (LB)
9.0	81	48	8.52	0.0034	1.1	
10.0	93	60	1.61	0.0040	1.2	1.2
11.0	65	126	2.18	0.0050	1.4	1.4
12.0	77	211	1.72	0.0060	6.16	16
13.0	90	294	6.26	0.0070	6.54	24.3
14.0	102	389	5.03	0.0080	6.78	31.1
15.0	114	497	6.36	0.0090	6.95	38.5

AD-A143 939 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS BRISTOL RESERVOIR NUM..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUN 81 2/2

UNCLASSIFIED F/G 13/13 NL



END
DATE FILMED
8-84
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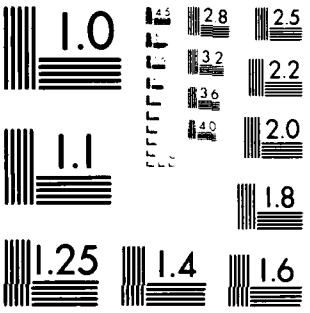


BY FAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 2 OF 5

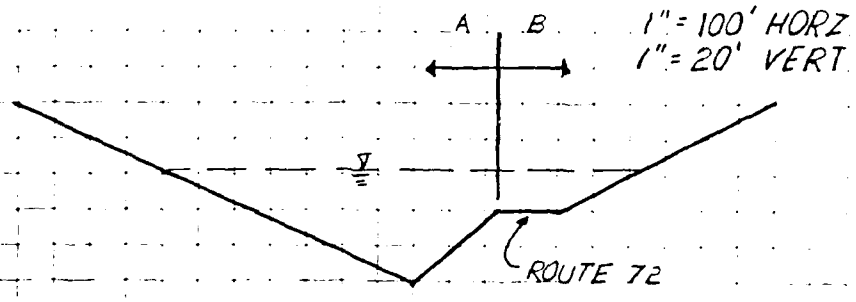
CONSULTING ENGINEERS

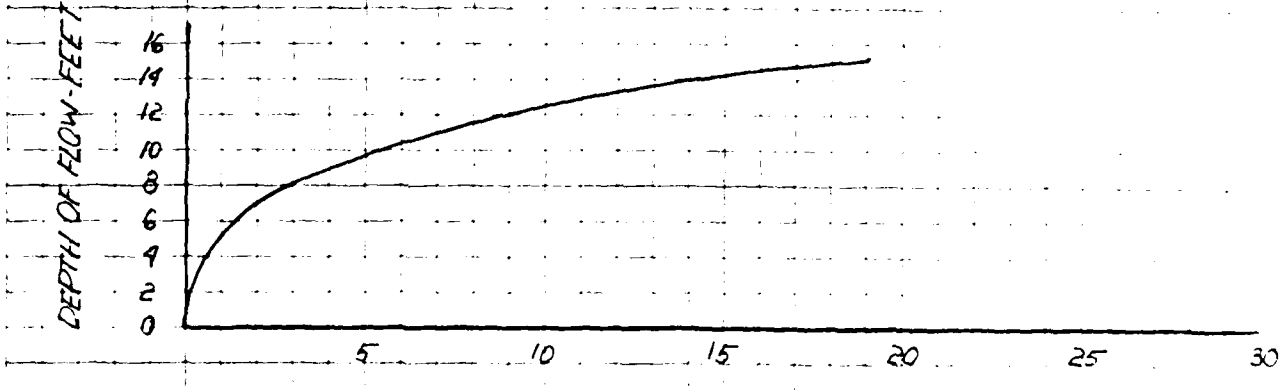
CKD BY SAL DATE 5-27-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 81-015

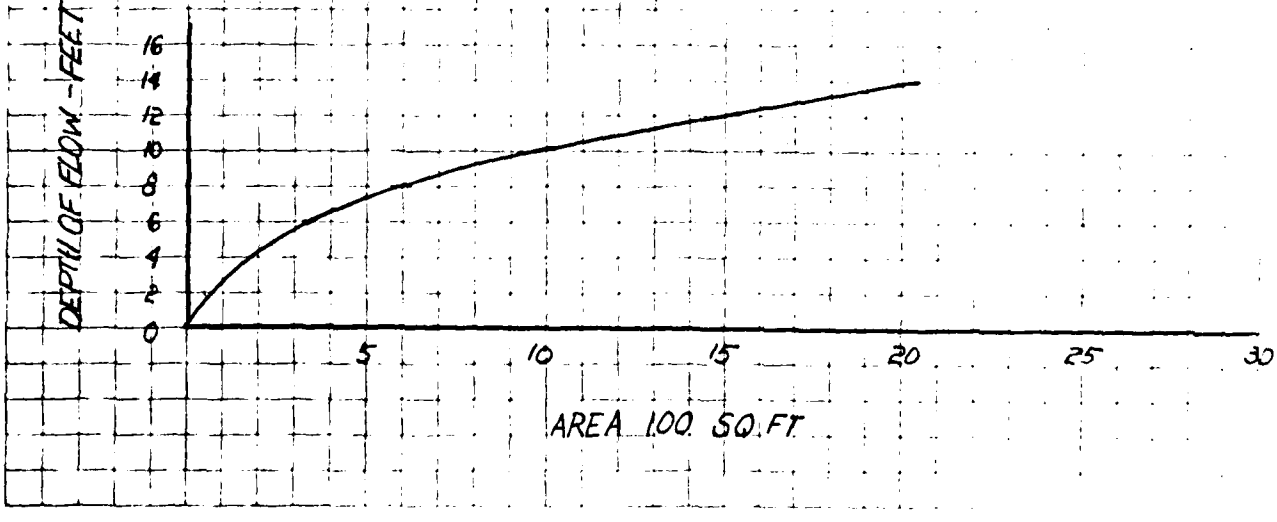
SUBJECT BRISTOL RESERVOIR NO 4 - FLOOD ROUTING

SECTION NO 5

L = 1800
S = 0.018
N(A) = 0.1
N(B) = 0.08







S.A.L 5/27/31

DLS 5/27/31

A (FT.)	B (FT.)	C (FT.)	D (FT.)	S (FT/FT)	V (FT/SEC)	D (FT.)
1.0	[illegible]	[illegible]	0.50	0.0024	0.62	[illegible]
2.0	324	55	1.00	0.0024	[illegible]	[illegible]
3.0	275	[illegible]	1.50	0.0024	[illegible]	[illegible]
4.0	248	[illegible]	2.11	0.0024	[illegible]	[illegible]
5.0	816	1[illegible]8	2.63	0.0024	[illegible]	[illegible]
6.0	478	1581	3.23	0.0024	[illegible]	[illegible]
7.0	585	2063	3.76	0.0024	[illegible]	[illegible]
8.0	613	2631	4.29	0.0024	[illegible]	[illegible]
9.0	680	3277	4.82	0.0024	[illegible]	[illegible]
10.0	746	3991	5.34	0.0024	[illegible]	[illegible]
11.0	815	4772	5.86	0.0024	[illegible]	[illegible]
12.0	883	5621	6.37	0.0024	[illegible]	[illegible]
13.0	951	6537	6.88	0.0024	[illegible]	[illegible]
14.0	1018	7520	7.39	0.0024	[illegible]	[illegible]
15.0	1086	8607	7.91	0.0024	[illegible]	[illegible]
16.0	1179	9754	8.34	0.0024	[illegible]	[illegible]
17.0	1281	[illegible]956	8.59	0.0024	[illegible]	[illegible]
18.0	1363	1.319	9.04	0.0024	[illegible]	[illegible]
19.0	1096	13723	[illegible]	0.0024	[illegible]	[illegible]
20.0	1528	[illegible]	9.95	0.0024	[illegible]	[illegible]

[illegible] COEFFICIENT=N=0.100

[illegible] OF TIME OF FAILURE=S= 905 [illegible]

LENGTH OF REACH=L= 1405 FT

INFLOW INTO REACH=QP1= 10535 CFS
DEPTH OF FLOW=H1= 13.0 FT.
CROSS SECTIONAL AREA=A1= 4607 SQ. FT.
STORAGE IN REACH=V1= 170.8 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 8897 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 10.0 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 3[illegible]9[illegible] SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)= 14[illegible].8 AC. FT.

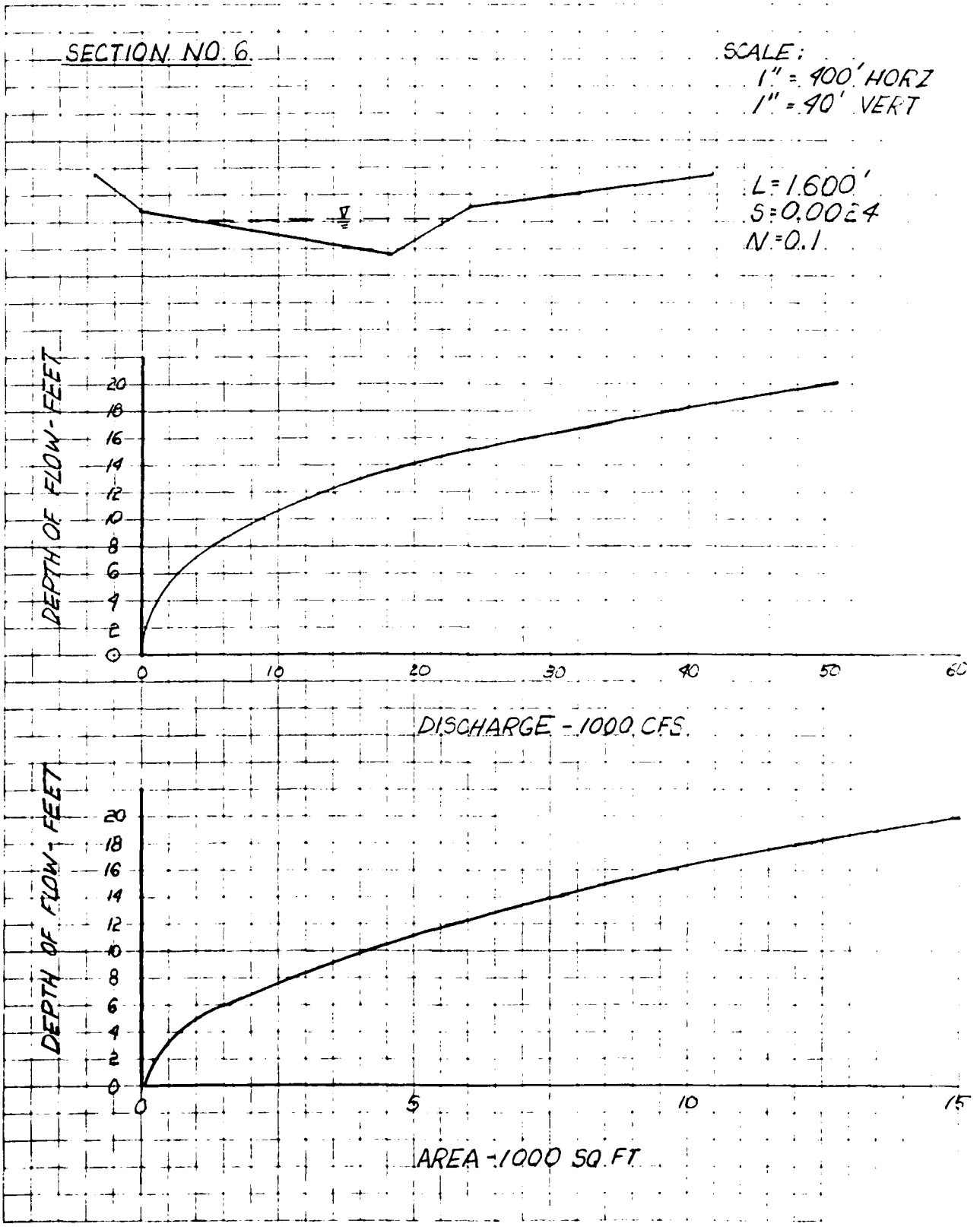
REACH OUTFLOW=QP2= 9020 CFS
DEPTH OF FLOW=H2= 10.1 FT.

BY PAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 2 OF 5

CONSULTING ENGINEERS

CKD BY CAL DATE 5-27-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 410-045

SUBJECT BRISTOL RESERVOIR NO 4 - FLOOD ROUTING



SAL 5/6/81

ILS 5/6/81

25

H (FT)	W (FT)	A (SQ-FT)	P (FT)	S (FT/FT)	V (FPS)	Q (CFS)
1.0	40	20	6.24	0.0024	0.65	13
2.0	80	80	12.49	0.0024	2.61	209
3.0	119	179	18.73	0.0024	5.86	1049
4.0	159	318	24.97	0.0024	10.41	3311
5.0	199	497	31.21	0.0024	16.26	8083
6.0	239	716	37.46	0.0024	23.41	16761
7.0	279	974	43.70	0.0024	31.86	31035
8.0	319	1272	49.94	0.0024	41.61	52930
9.0	405	1632	56.18	0.0024	53.36	87084
10.0	440	2053	62.43	0.0024	67.41	138381
11.0	479	2510	68.67	0.0024	82.46	206999
12.0	518	3002	74.91	0.0024	98.61	296078
13.0	558	3529	81.15	0.0024	115.86	408844
14.0	597	4091	87.39	0.0024	134.21	549093
15.0	636	4689	93.64	0.0024	153.66	720722
16.0	677	5321	99.88	0.0024	174.21	926999
17.0	716	5989	106.12	0.0024	195.86	1172999
18.0	756	6692	112.36	0.0024	218.61	1462999

MANNING COEFFICIENT=N=0.1000

STORAGE AT TIME OF FAILURE=S= [illegible] AC. FT.

LENGTH OF REACH= [illegible] FT.

INFLOW INTO REACH=QI= [illegible] CFS

DEPTH OF FLOW=H1= 13.0 FT.

CROSS SECTIONAL AREA=A1= 3010 SQ.FT.

STORAGE IN REACH=V1= 1[illegible].9 AC. FT.

TRIAL REACH OUTFLOW=QO(TRIAL)= 7[illegible] CFS

TRIAL DEPTH OF FLOW=H(TRIAL)= [illegible].8 FT.

TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 3010 SQ.FT.

TRIAL STORAGE IN REACH=V(TRIAL)= 1[illegible].3 AC. FT.

REACH OUTFLOW=QO= 7[illegible] CFS

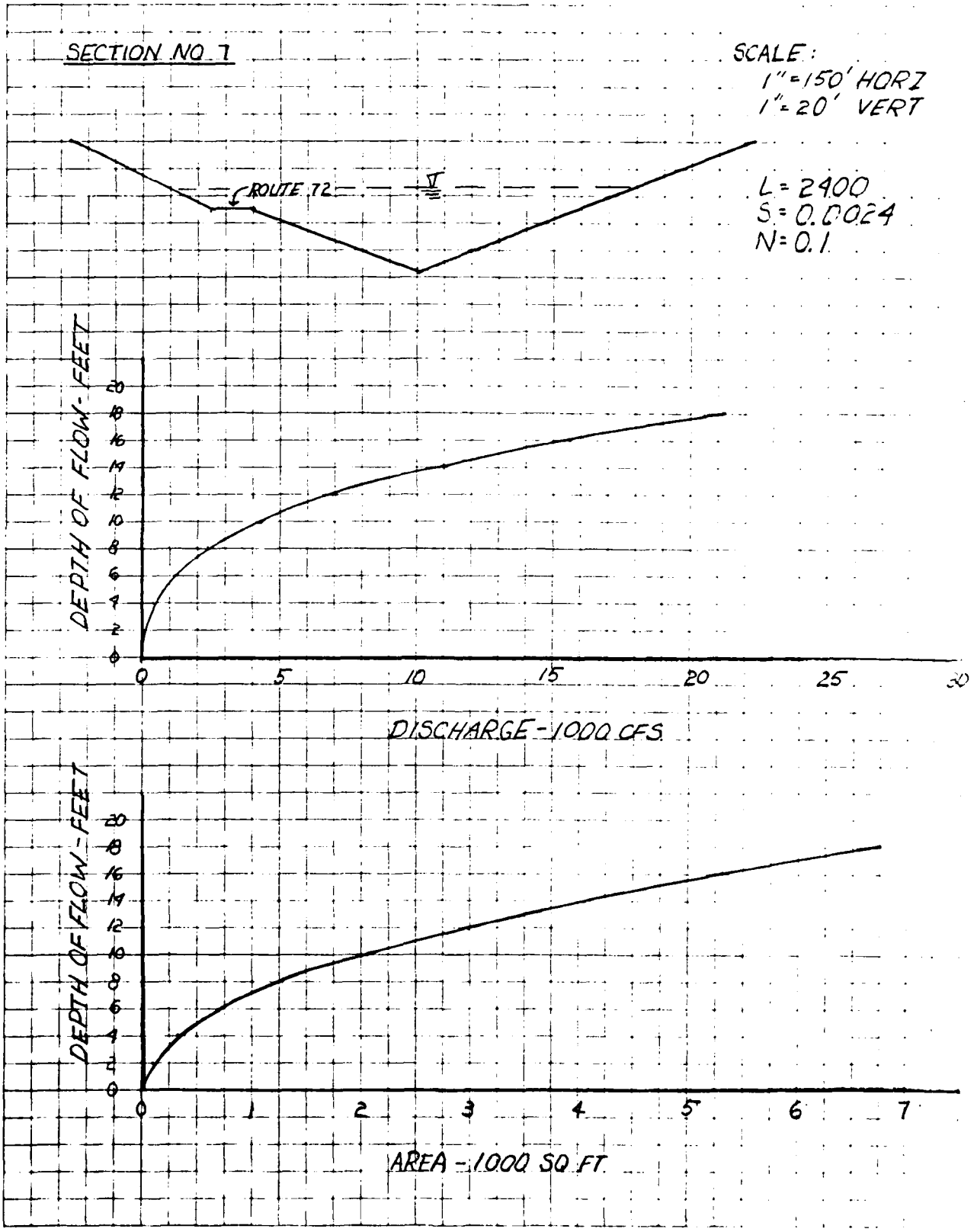
DEPTH OF FLOW=H2= [illegible] FT.

BY PAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 26 OF 75

CONSULTING ENGINEERS

CKD BY SAL DATE 5-27-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 046-045

SUBJECT BRISTOL RESERVOIR NO. 4 - FLOOD ROUTING



EAL 5/27/81

DLS 5/27/81

H (FT)	Q (CFS)	A (SQ-FT)	P (FT)	S (FT/FT)	V (FT/SEC)	D (IN)
1.0	28	15	5.50	0.0100	2.00	12
2.0	60	40	11.00	0.0100	1.50	24
3.0	96	75	16.50	0.0100	1.28	36
4.0	120	100	22.00	0.0100	1.20	48
5.0	150	125	27.50	0.0100	1.15	60
6.0	181	150	33.00	0.0100	1.08	72
7.0	211	175	38.50	0.0100	1.03	84
8.0	241	200	44.00	0.0100	1.00	96
9.0	271	225	49.50	0.0100	0.98	108
10.0	301	250	55.00	0.0100	0.96	120
11.0	346	275	60.50	0.0100	0.95	132
12.0	391	300	66.00	0.0100	0.94	144
13.0	436	325	71.50	0.0100	0.93	156
14.0	481	350	77.00	0.0100	0.92	168
15.0	526	375	82.50	0.0100	0.91	180
16.0	571	400	88.00	0.0100	0.90	192

MANNING COEFFICIENT(N)= 0.030

STORAGE AT TIME OF FAILURE= 500 AC. FT.

LENGTH OF REACH= 2500 FT

[illegible] = 0.00

DEPTH OF FLOW=H1= 10.0 FT.

CROSS SECTIONAL AREA=A1= 1650 SQ.FT.

STORAGE IN REACH=V1= 75.8 AC FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 6700 CFS

TRIAL DEPTH OF FLOW=H(TRIAL)= 18.1 FT.

TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 1500 [illegible]

TRIAL STORAGE IN REACH=V(TRIAL)= [illegible]

REACH OUTFLOW=Q2= 6728 CFS

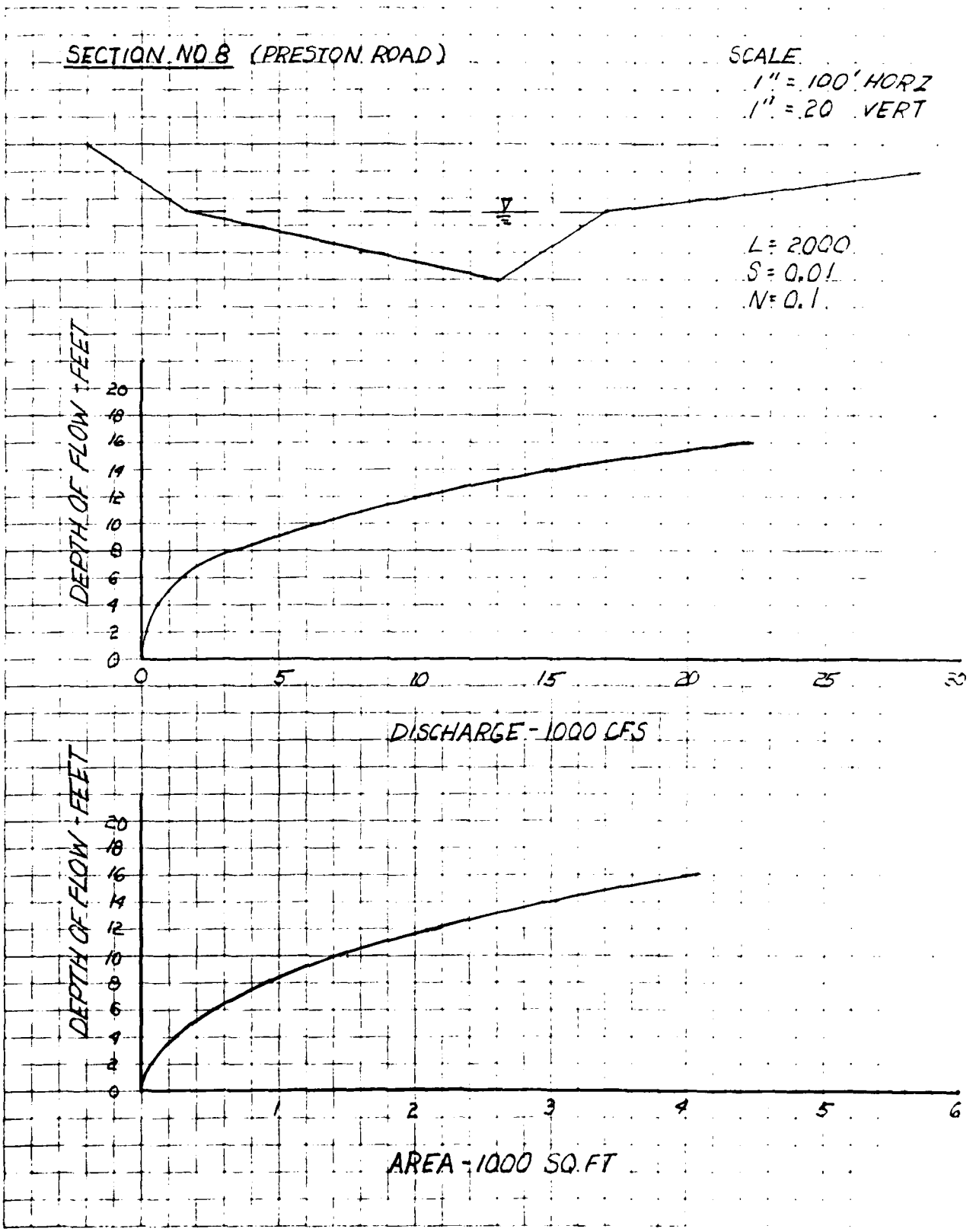
DEPTH OF FLOW=H2= 18.1 FT.

BY PAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 6.5 OF 7

CONSULTING ENGINEERS

CKD BY SHH DATE 5-27-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-04

SUBJECT BRISTOL RESERVOIR NO 4 - FLOOD ROUTING



SHL 5/27/81

DLS DATE 5/27/81

SECTION NUMBER 9

TOTAL SECTION

H (FT)	U (FT)	A (SQ-FT)	P (FT)	S (FT/FT)	V (FT/SEC)	Q (CFS)
1.0	28	14	8.58	0.0087	1.20	17.
2.0	55	55	7.10	0.0087	1.99	110
3.0	83	124	11.50	0.0087	2.66	330
4.0	110	220	14.92	0.0087	3.24	713
5.0	138	344	18.49	0.0087	3.74	1287
6.0	165	495	21.99	0.0087	4.11	2034
7.0	193	674	25.49	0.0087	4.56	3073
8.0	221	880	28.99	0.0087	4.95	4356
9.0	248	1114	32.49	0.0087	5.39	6006
10.0	276	1375	35.99	0.0087	5.78	7945
11.0	299	1656	39.74	0.0087	6.35	10517
12.0	301	1950	46.47	0.0087	6.85	13357
13.0	314	2256	47.14	0.0087	7.37	16627
14.0	327	2575	47.84	0.0087	7.84	20188
15.0	339	2906	48.56	0.0087	8.29	24091

MANNING COEFFICIENT=N=0.0750

STORAGE AT TIME OF FAILURE=S= 945 AC. FT.

LENGTH OF REACH=L= 3000 FT.

INFLOW INTO REACH=QP1= 6725 CFS

DEPTH OF FLOW=H1= 9.1 FT.

CROSS SECTIONAL AREA=A1= 1213 SQ.FT.

STORAGE IN REACH=V1= 83.4 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 6134 CFS

TRIAL DEPTH OF FLOW=H(TRIAL)= 9.1 FT.

TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 1132 SQ.FT.

TRIAL STORAGE IN REACH=V(TRIAL)= 77.9 AC. FT.

REACH OUTFLOW=QP2= 6154 CFS

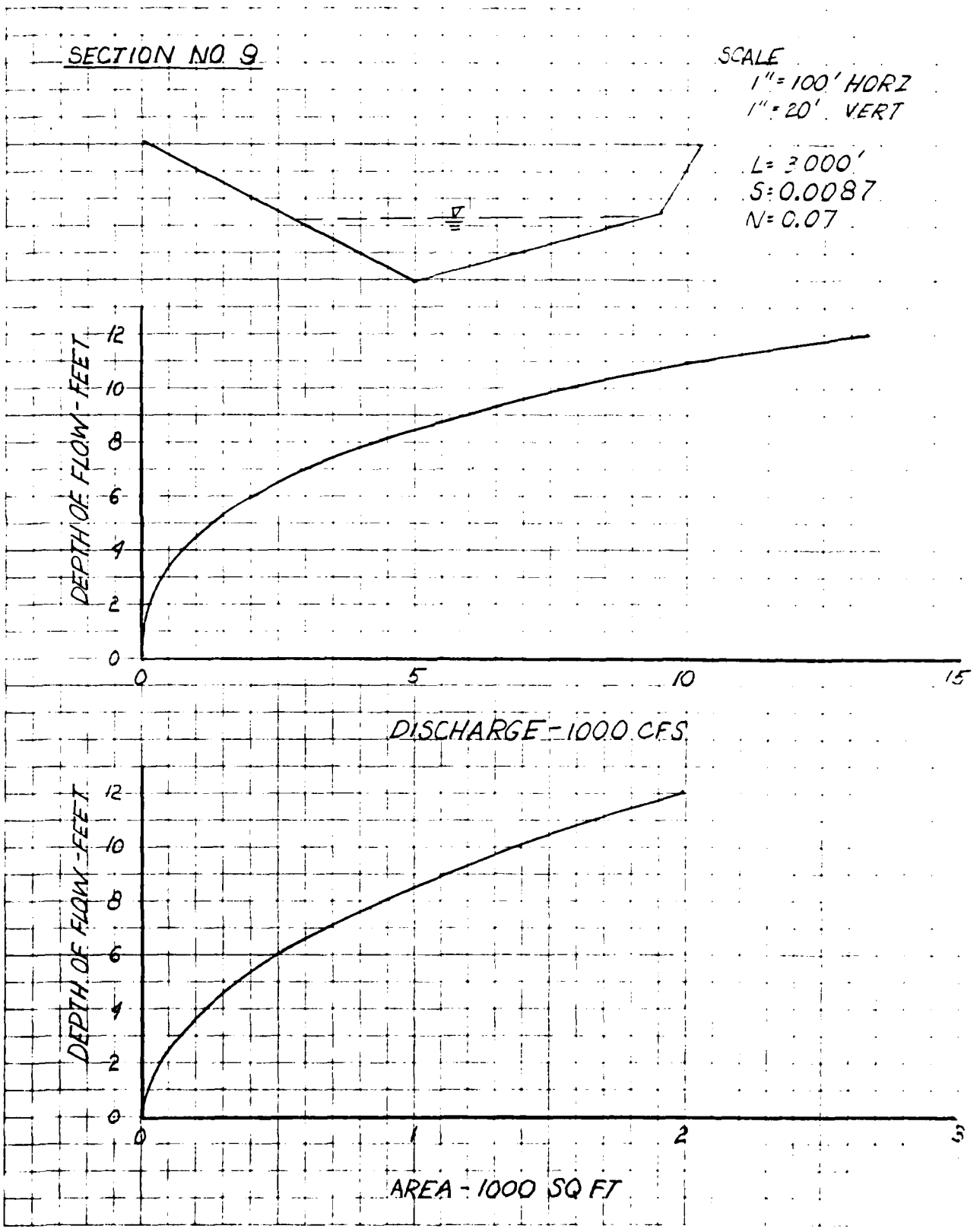
DEPTH OF FLOW=H2= 9.1 FT.

BY FAM DATE 5-1-81 **ROALD HAESTAD, INC.** SHEET NO 5A OF 5

CONSULTING ENGINEERS

CKD BY SAL DATE 5-27-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 049-045

SUBJECT BRISTOL RESERVOIR NO. 4 - FLOOD ROUTING



SHL 5/27/81

DLS 5/27/81

MAIN CHANNEL

H (FT)	U (FT)	Q (CFS)	R (FT)	S (FT/FT)	V (FT/SEC)	D (FT)
1.0	15	7	0.50	0.0059	1.5	1
2.0	35	45	0.99	0.0059	2.7	1
3.0	53	99	1.49	0.0059	3.5	2
4.0	70	168	1.99	0.0059	4.1	3
5.0	88	257	2.48	0.0059	4.7	4
6.0	106	365	2.98	0.0059	5.2	5
7.0	124	489	3.48	0.0059	5.6	6
8.0	141	628	3.97	0.0059	6.0	7
9.0	159	780	4.47	0.0059	6.3	8
10.0	176	945	4.97	0.0059	6.6	9
11.0	179	1051	5.58	0.0059	7.4	10
12.0	182	1230	6.78	0.0059	8.1	12
13.0	184	1411	7.66	0.0059	8.8	13
14.0	187	1595	8.53	0.0059	9.3	14
15.0	190	1781	9.39	0.0059	10.1	15
16.0	192	1979	10.29	0.0059	10.7	16
17.0	195	2161	11.09	0.0059	11.2	17
18.0	198	2355	11.91	0.0059	11.8	18
19.0	200	2551	12.75	0.0059	12.3	19
20.0	203	2750	13.54	0.0059	12.9	20

MANNING COEFFICIENT=0.040

SAL : 5/27/81

DLC 5-29

H (FT)	U (FT)	A (SQ FT)				
11.0	52	89	[illegible]	[illegible]		
12.0	55	102	[illegible]	[illegible]	[illegible]	[illegible]
13.0	58	154	[illegible]	[illegible]	[illegible]	[illegible]
14.0	61	217	3.56	0.0059	[illegible]	[illegible]
15.0	63	278	4.39	0.0059	[illegible]	[illegible]
16.0	66	341	5.17	0.0059	[illegible]	[illegible]
17.0	69	408	5.93	0.0059	[illegible]	[illegible]
18.0	71	476	6.67	0.0059	[illegible]	[illegible]
19.0	74	546	7.38	0.0059	[illegible]	[illegible]
20.0	77	621	8.08	0.0059	[illegible]	[illegible]

MANNING COEFFICIENT=N=0.0500

SHL 5/07/21

DLS 5/07/21

H	A	P	T	R
1.0	9	0	9	16
2.0	35	0	5	30
3.0	79	1	7	24
4.0	140	0	10	5
5.0	219	0	19	11
6.0	315	0	15	14
7.0	429	0	29	1
8.0	560	0	56	7
9.0	709	0	20	4
10.0	876	0	37	3
11.0	1951	99	1103	7.1
12.0	1230	102	1352	10.9
13.0	1411	102	1559	12.9
14.0	1595	217	1912	15.0
15.0	1781	278	2089	14.0
16.0	1976	367	2611	21.2
17.0	2181	408	2589	24.3
18.0	2395	476	2831	29.4
19.0	2551	581	3059	31.5
20.0	2756	629	3271	34.6

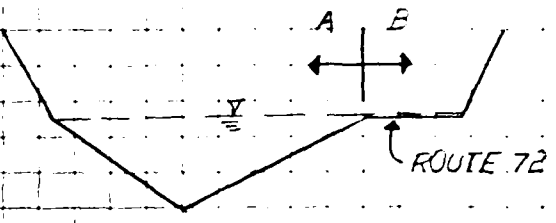
BY EAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 1 OF 7

CONSULTING ENGINEERS

CKD BY SAL DATE 5-21-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 149-47

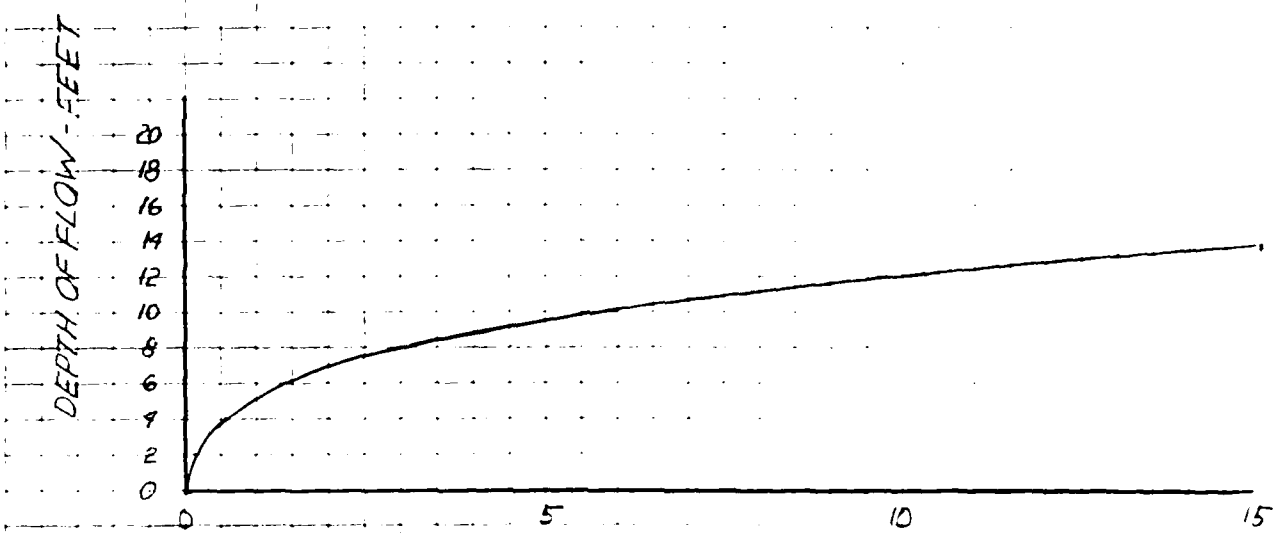
SUBJECT BRISTOL RESERVOIR NO. 4 - FLOOD ROUTING

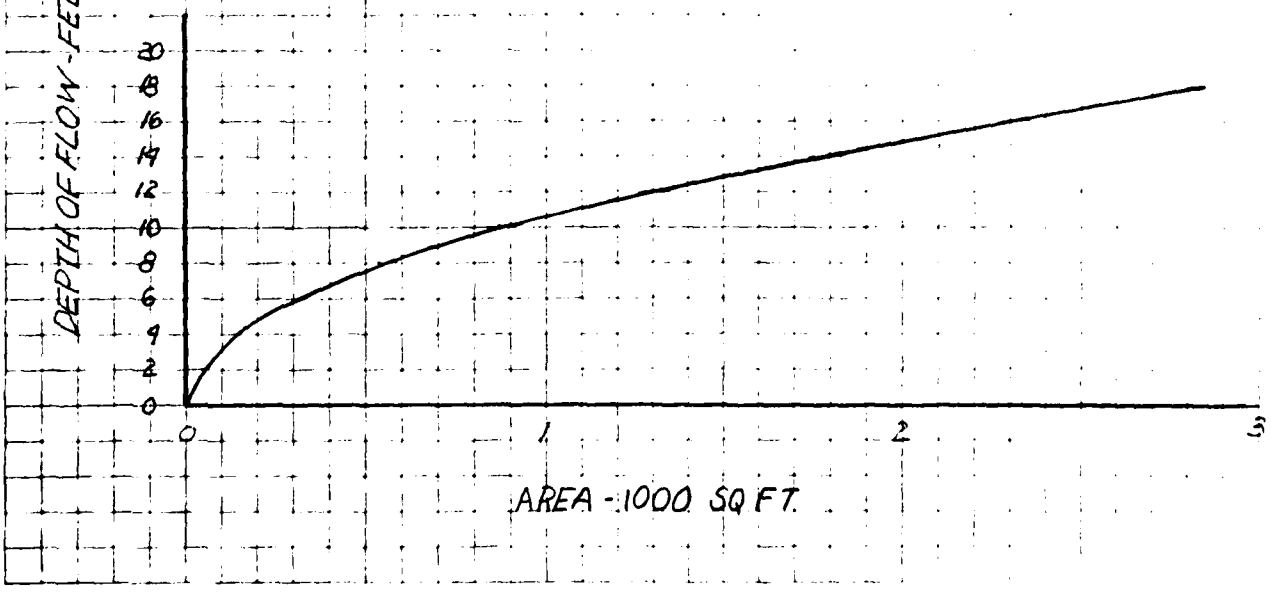
SECTION NO 10



SCALE
1" = 100' HORZ
1" = 20' VERT

L = 1300'
S = 0.0053
N(A) = 0.05
N(B) = 0.05



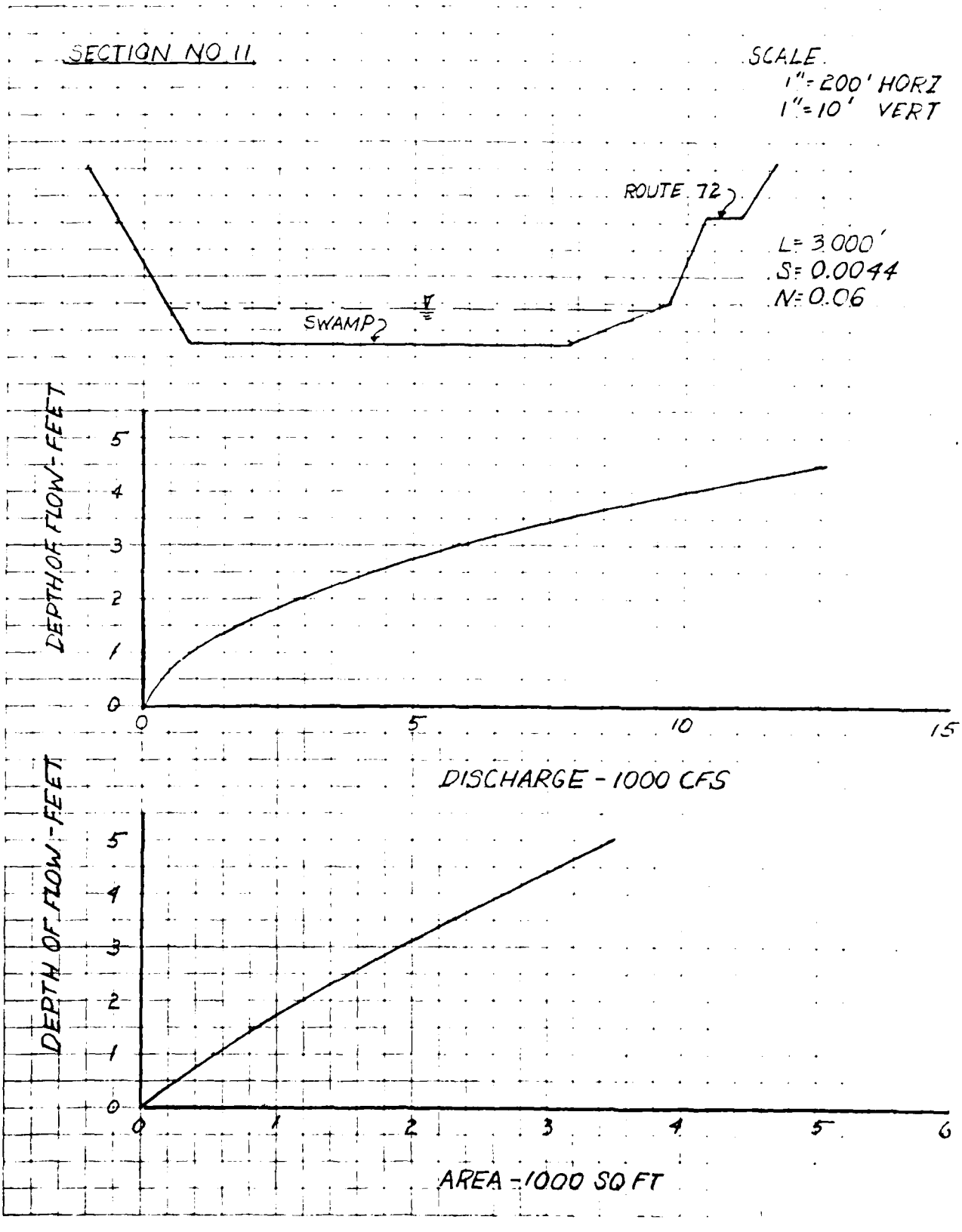


BY FAM DATE 5-1-81 **ROALD HAESTAD, INC.** SHEET NO 5 OF 7

CONSULTING ENGINEERS

CKD BY SAL DATE 5-22-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 442-045

SUBJECT BRISTOL RESERVOIR NO. 4 — FLOOD ROUTING



SAL 5/27/81

DLS 5/27/81

EAL 5/07/81

DLO 5/07/81

0	104	0	104	0	0	
0	307	0	307	0	0	
0	476	0	476	0	0	
4.0	653	0	653	2613	0	
8.0	858	0	858	2962	0	
8.0	1051	0	1051	4064	0	
0	1279	49	1278	5284	0	
0	1434	104	1538	6704	0	
0	1640	127	1413	8555	0	
10.6	1868	142	1905	10056	0	

STORAGE AT TIME OF INFLOW=S= 0. AC-FT

LENGTH OF REACH=L= 5280. FT

INFLOW INTO REACH=Q1= 0. CFS

DEPTH OF FLOW=D1= 0.00 FT

CROSS SECTIONAL AREA=A1= 0.00 SQ FT

STORAGE IN REACH=V1= 0. AC-FT

FIRST APPROXIMATION OUTFLOW=QP(TRIAL)= 0.0 CFS

FIRST APPROXIMATION DEPTH=H(TRIAL)= 0.00 FT

FIRST APPROXIMATION FLOW AREA=A(TRIAL)= 0.0 SQ FT

TRIAL STORAGE IN REACH=V(TRIAL)= 0. AC-FT

REACH OUTFLOW=QP2= N/A CFS

DEPTH OF FLOW=H2= 0.00 FT

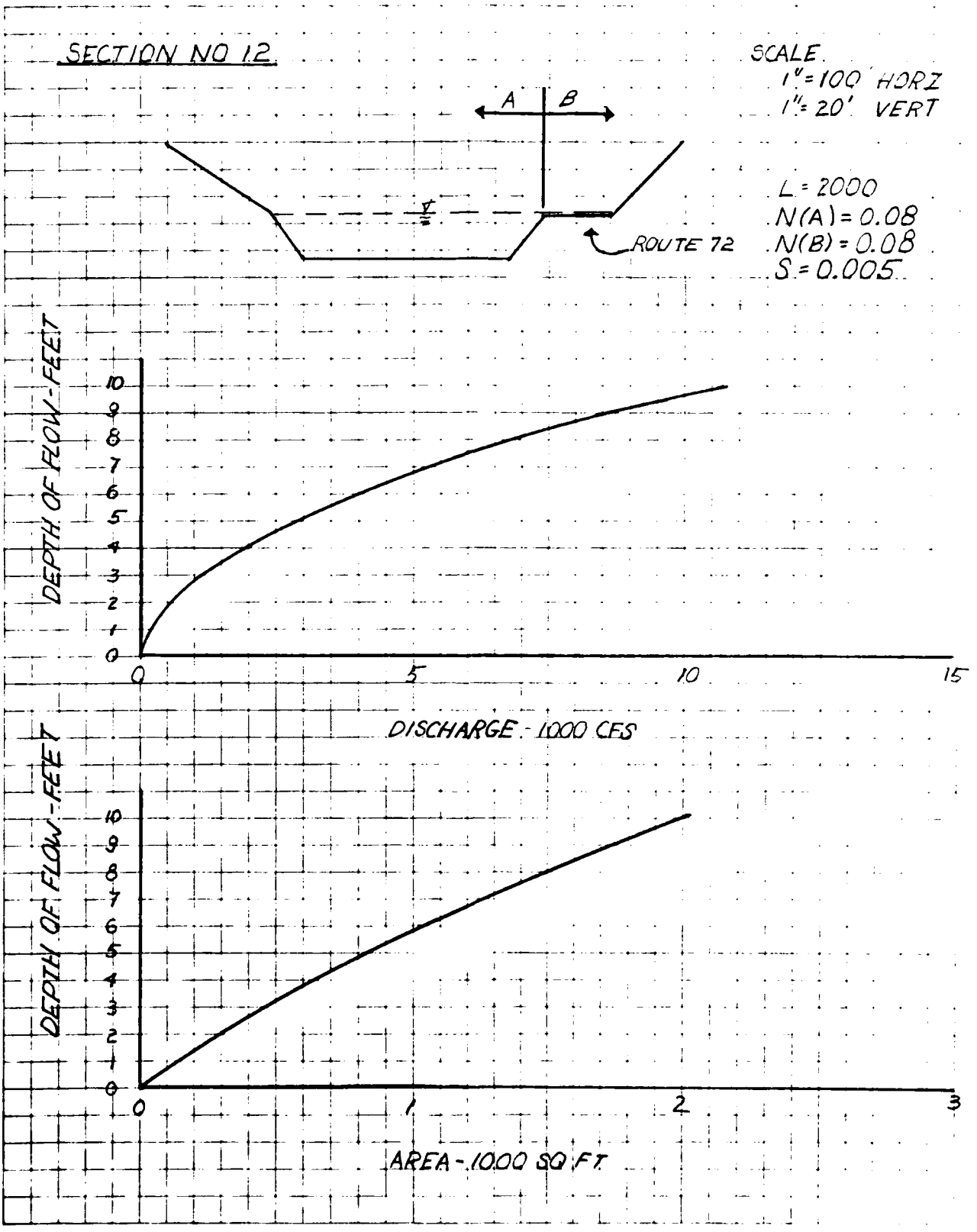
BY PAM DATE 5-21-81 **ROALD HAESTAD, INC.** SHEET NO 2 OF 4

CONSULTING ENGINEERS

CKD BY SAL DATE 5-27-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 419-045

SUBJECT BRISTOL RESERVOIR NO. 4 - FLOOD ROUTING

SECTION NO 12



EAL 5/27/81

DLS 5/27/81

H (FT)						
1.0	20	10	0.50	1.61E+0	2.24	
2.0	40	40	1.00	8.94E+0	8.94	
3.0	60	90	1.45	2.01E+1	13.86	
4.0	80	160	1.90	3.58E+1	18.83	
5.0	100	250	2.35	5.59E+1	23.78	
6.0	121	360	2.83	8.15E+1	28.78	
7.0	141	490	3.46	1.13E+2	32.80	
8.0	161	644	4.19	1.49E+2	35.56	
9.0	181	810	5.03	1.91E+2	37.98	
10.0	201	1000	4.99	2.41E+2	48.26	

MANNING COEFFICIENT=N= 0.040

STORAGE AT TIME OF FAILURE=S= 1000. FT

LENGTH OF REACH=L= 1000. FT

INFLOW INTO REACH=QPI= 45.4 CFS

DEPTH OF FLOW=HI= 2.11 FT

CROSS SECTIONAL AREA=A= 40 SQ FT

STORAGE IN REACH=V1= 1.2 AC. FT

TRIAL REACH OUTFLOW=QP= 0.0 CFS

TRIAL DEPTH OF FLOW= 0.00 FT

TRIAL CROSS SECTIONAL AREA= 0.0 SQ FT

TRIAL STORAGE IN REACH=V=TRIAL= 0.0 AC. FT

REACH OUTFLOW=QP= 0.0 CFS

DEPTH OF FLOW=H= 0.00 FT

BY PAM DATE 5-7-81 **ROALD HAESTAD, INC.** SHEET NO 1 OF 1

CONSULTING ENGINEERS

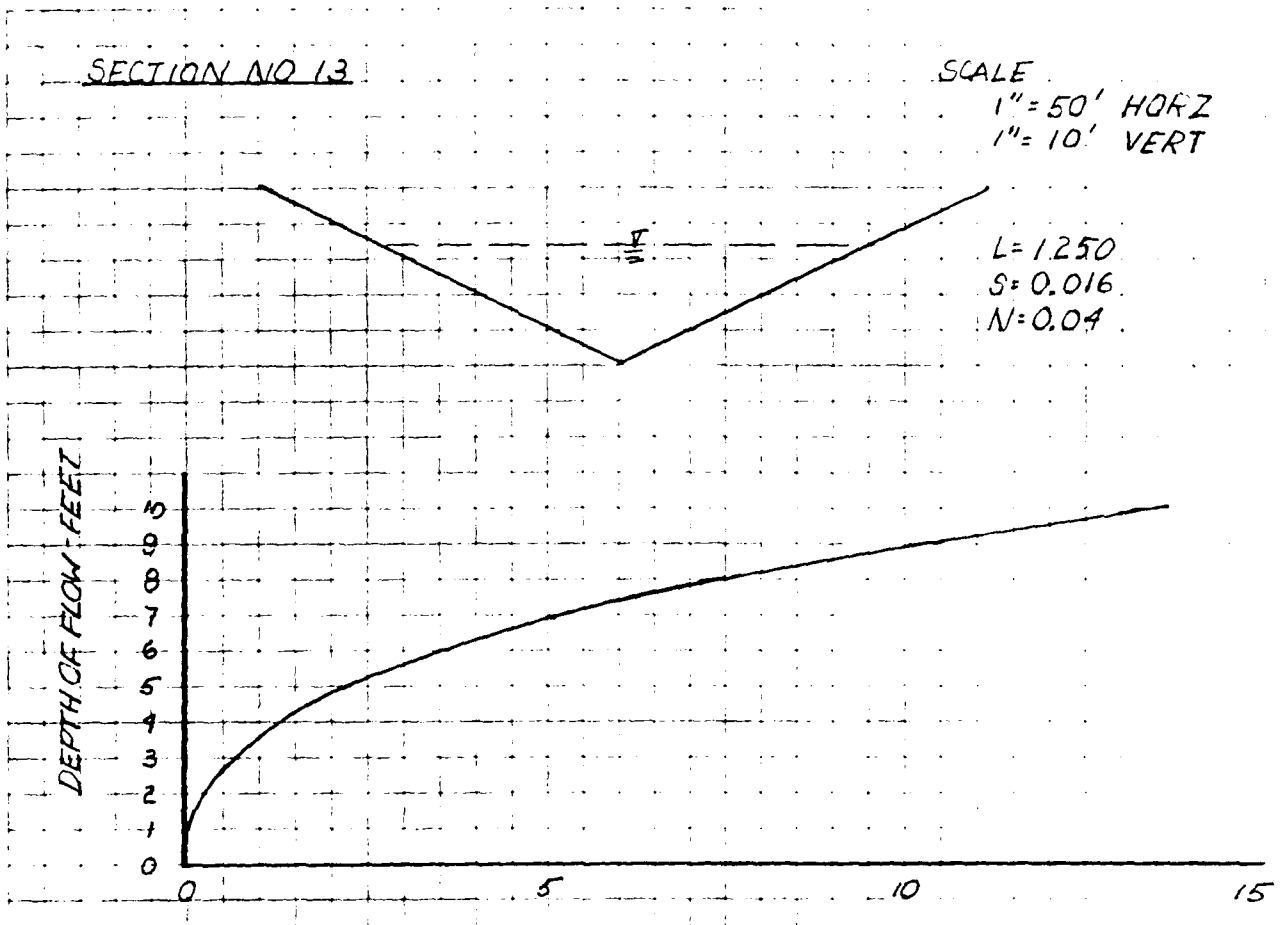
CKD BY SH DATE 5-7-81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 312-45

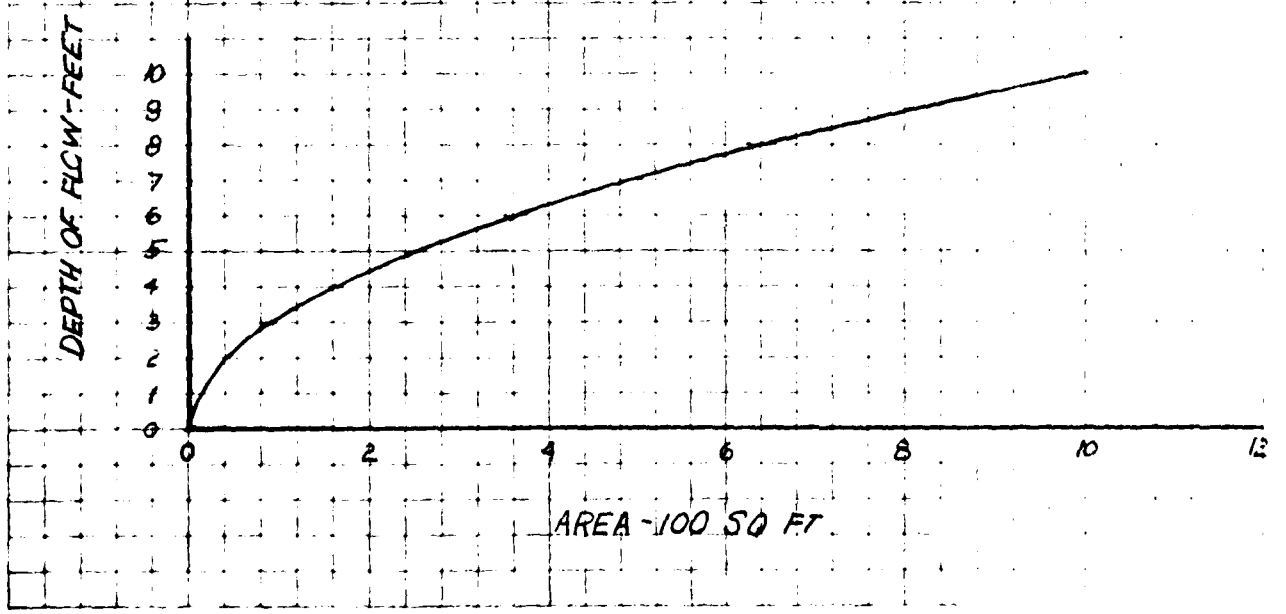
SUBJECT BRISTOL RESERVOIR NO 4 - FLOOD ROUTING

SECTION NO 13

SCALE
1" = 50' HORZ
1" = 10' VERT

L = 1250
S = 0.016
N = 0.04





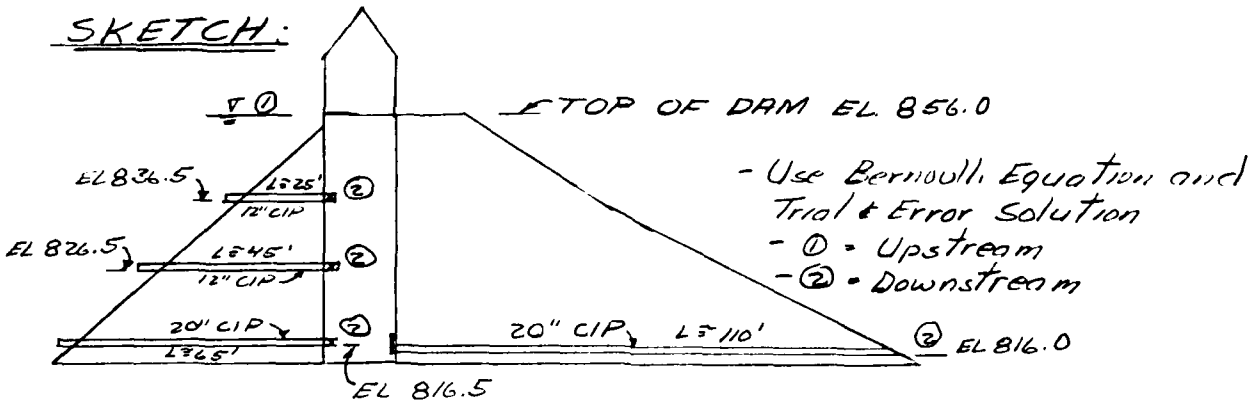
BY SAL DATE 5/27/81 **ROALD HAESTAD, INC.** SHEET NO 25 OF

CONSULTING ENGINEERS

CKD BY DLS DATE 5/27/81 37 Brookside Road - Waterbury, Conn. 06708 JOB NO

SUBJECT BRISTOL RESERVOIR NO. 4 - Outlet Piping Capacity

SKETCH:



- Use Bernoulli Equation and Trial & Error Solution
- ① - Upstream
- ② - Downstream

Head losses: 1) Friction $f\frac{L}{D}\frac{V_2^2}{2g}$
2) Entrance - projecting $K\frac{V_2^2}{2g}$ $(K = 1)$
3) " - flush $K\frac{V_2^2}{2g}$ $(K = 0.5)$
4) Gate Valve $K\frac{V_2^2}{2g}$ $(K = 0.25)$

12" CIP @ EL 836.5:

$$Z_1 + P_1/\gamma + V_1^2/2g = Z_2 + P_2/\gamma + V_2^2/2g + H_{L1-2}$$
$$19.5 + 0 + 0 = 0 + 0 + V_2^2/2g + [25f + 1 + 0.25]\,V_2^2/2g$$
$$19.5 = (25f + 2.25)\,V_2^2/2g$$

$V_{2\,assumed} = 10$ ft/sec $\rightarrow f = 0.0375$ $\therefore V_2 = 19.8$ ft/sec
" " $= 20$ ft/sec $\rightarrow f = 0.0365$ $\therefore V_2 = 19.9$ ft/sec

$$Q_{TOP\ OF\ DAM} = V_2 A = 19.9\,(\pi(1)^2/4) = 16 \text{ cfs}$$

12" CIP @ EL 826.5:

$$29.5 = (45f + 2.25)\,V_2^2/2g$$

$V_{2\,assumed} = 20$ ft/sec $\rightarrow f = 0.0365$ $\therefore V_2 = 22.1$ ft/sec
" " $= 22$ ft/sec $\rightarrow f = 0.0364$ $\therefore V_2 = 22.1$ ft/sec

$$Q_{TOP\ OF\ DAM} = V_2 A = 22.1\,(\pi(1)^2/4) = 17 \text{ cfs}$$

20" CIP @ EL 816.5:

$$39.5 = (39f + 2.25)\,V_2^2/2g$$

$V_{2\,assumed} = 25$ ft/sec $\rightarrow f = 0.0350$ $\therefore V_2 = 26.5$ ft/sec
" " $= 26.5$ ft/sec $\rightarrow f = 0.0350$ $\therefore V_2 = 26.5$ ft/sec

$$Q_{TOP\ OF\ DAM} = A V_2 = \left(\pi(\tfrac{20}{12})^2/4\right) 26.5 \text{ ft/sec} = 58 \text{ cfs}$$

BY S.A.L. DATE 5/27/81 **ROALD HAESTAD, INC.** SHEET NO. ... OF ...

CONSULTING ENGINEERS

CKD BY ... DATE ... 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-045

SUBJECT BRISTOL RESERVOIR NO. 4 - Outlet Piping Capacity

20" CIP @ EL 816: (Outlet from Gatehouse)

$$z_1 + P_1/\gamma + V_1^2/2g = z_2 + P_2/\gamma + V_2^2/2g + H_{L1-2}$$

$$40 + 0 + 0 = 0 + 0 + V_2^2/2g + [66f + 0.5]\, V_2^2/2g$$

$$40 = (66f + 1.5)\, V_2^2/2g$$

V_2 assumed = 20 ft/sec $\rightarrow f = 0.0350$ $\therefore V_2 = 26$ ft/sec

" = 26 ft/sec $\rightarrow f = 0.0350$ $\therefore V_2 = 26$ ft/sec

$$Q_{TOP\ OF\ DAM} = V_2 A = 26 \left(\pi (29/12)^2 / 4 \right)$$

$$= 57 \text{ cfs}$$

BY ... DATE ... **ROALD HAESTAD, INC.** SHEET NO ... OF ...

CONSULTING ENGINEERS

CKD BY ... DATE ... 37 Brookside Road - Waterbury, Conn. 06708 JOB NO ...

SUBJECT ...

PLANIMETER READINGS:
(SCALE: 1" = 2000')

WATER SURFACE	THIRD	43.59	SQ.IN.	C.44	40.4 ACRES
	FIRST	42.73	SQ.IN.	C.46	
	START	42.27	SQ.IN.		
WATERSHED	THIRD	49.43	SQ.IN	12.05	1107 ACRES
	FIRST	25.34	SQ.IN	12.05	= 1.73 SQ. MI.
	START	13.29	SQ.IN.		
CONTOUR 866	THIRD	16.55	SQ.IN.	C.62	57.2 ACRES
	FIRST	15.32	SQ.IN	C.64	
	START	14.68	SQ.IN.		

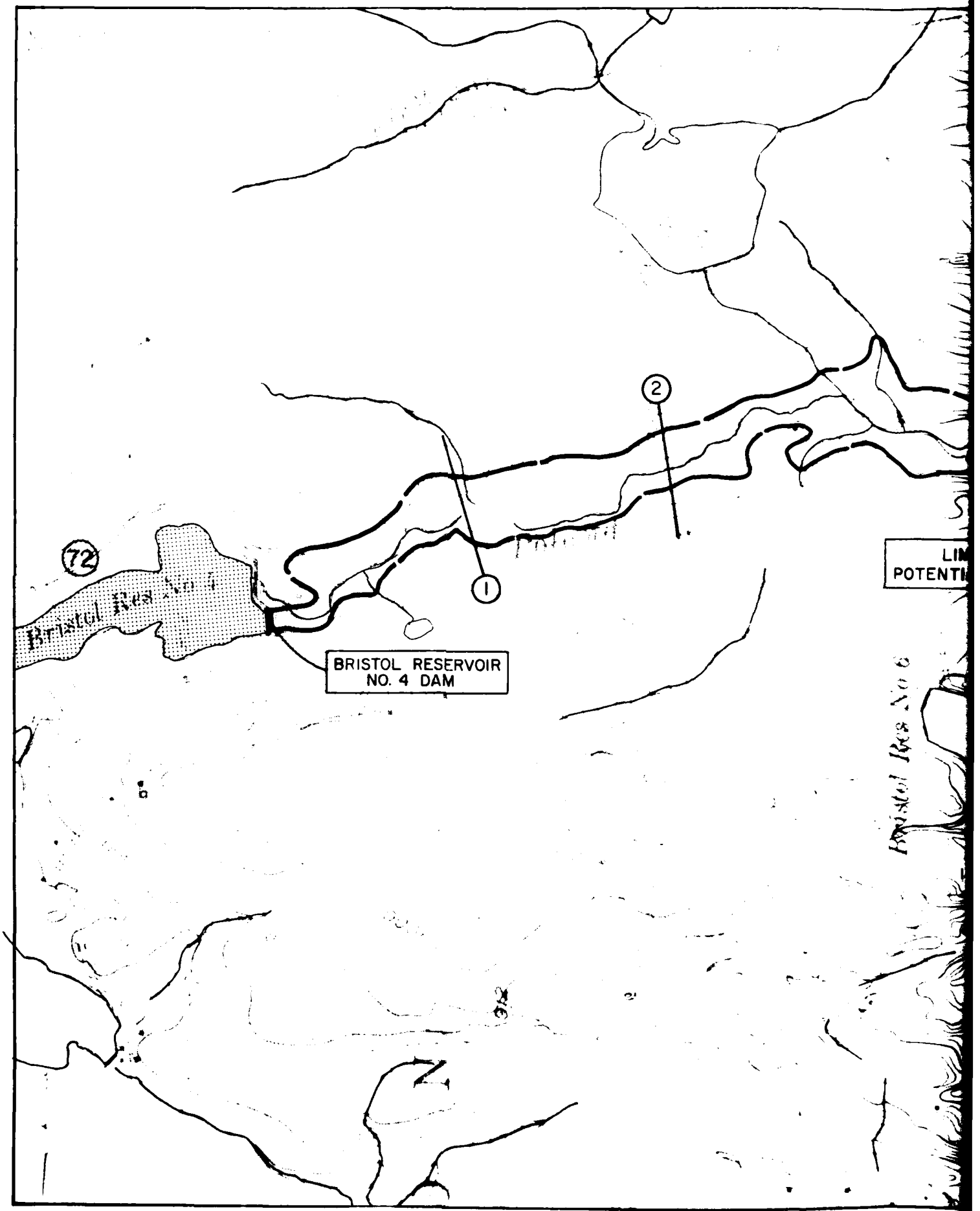
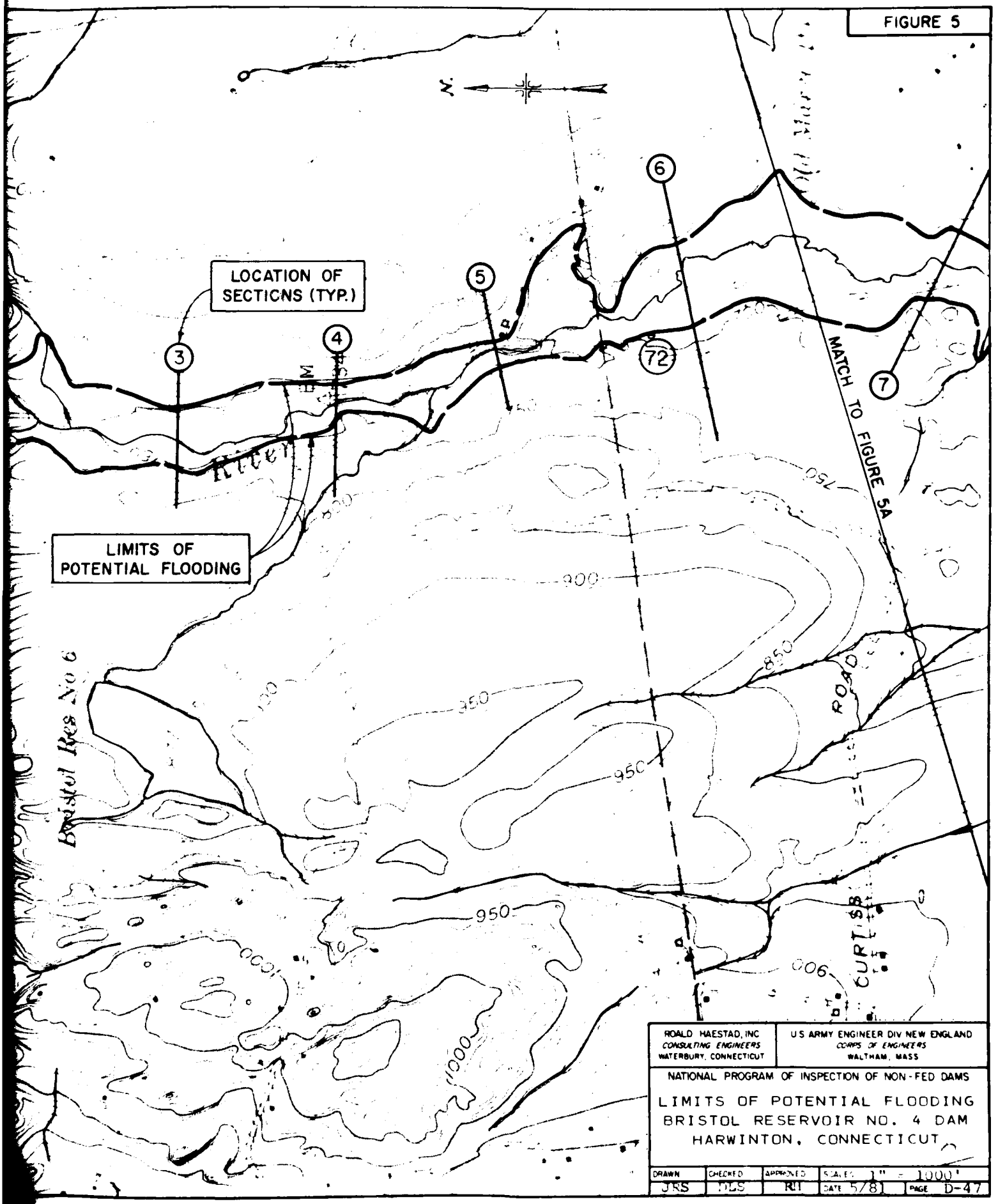

72
1
2
BRISTOL RESERVOIR
NO. 4 DAM
LI
POTENTI

FIGURE 5



ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LIMITS OF POTENTIAL FLOODING
BRISTOL RESERVOIR NO. 4 DAM
HARWINTON, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALE: 1" = 1000'
JRS	DLS	RH	DATE 5/81 PAGE D-47

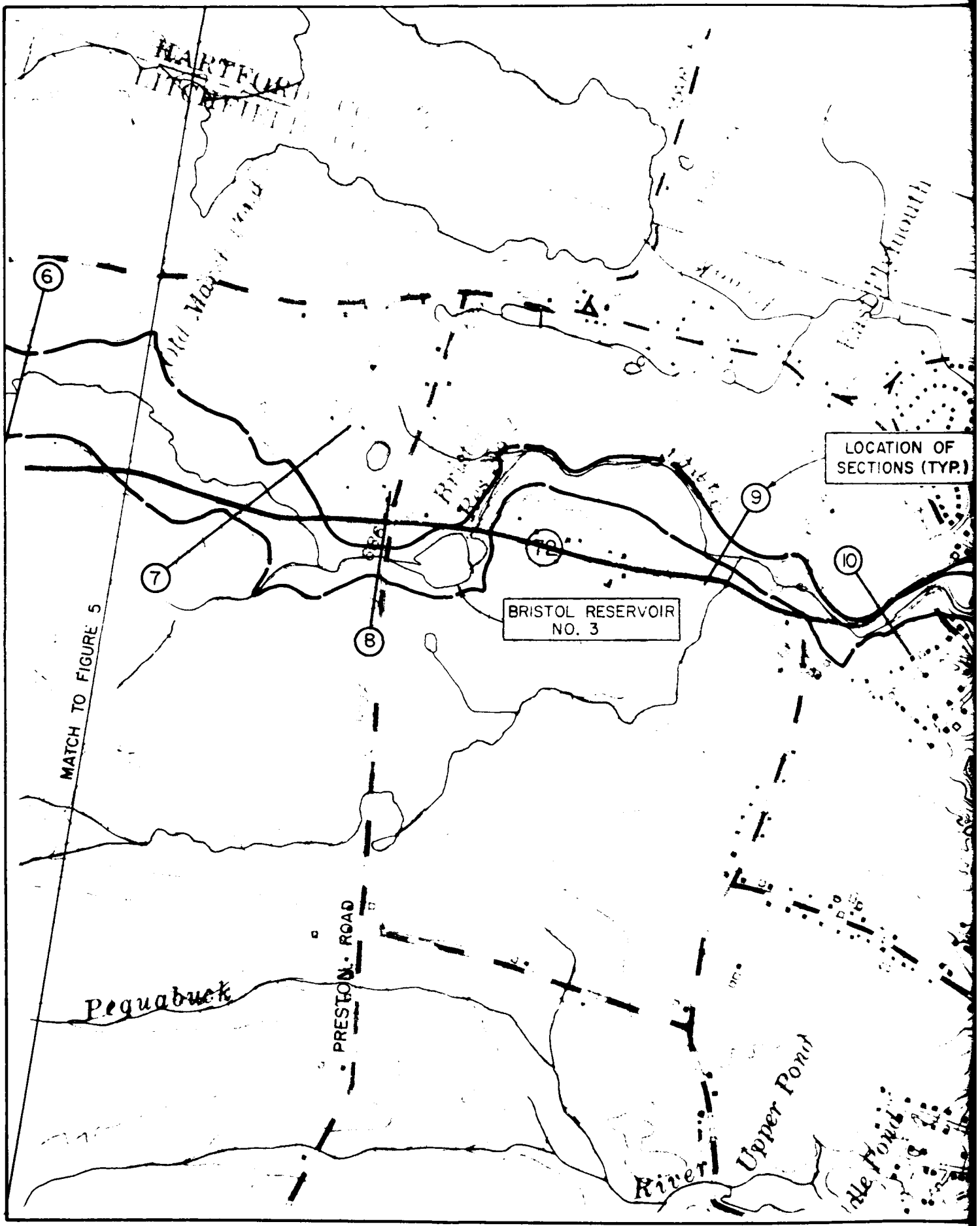
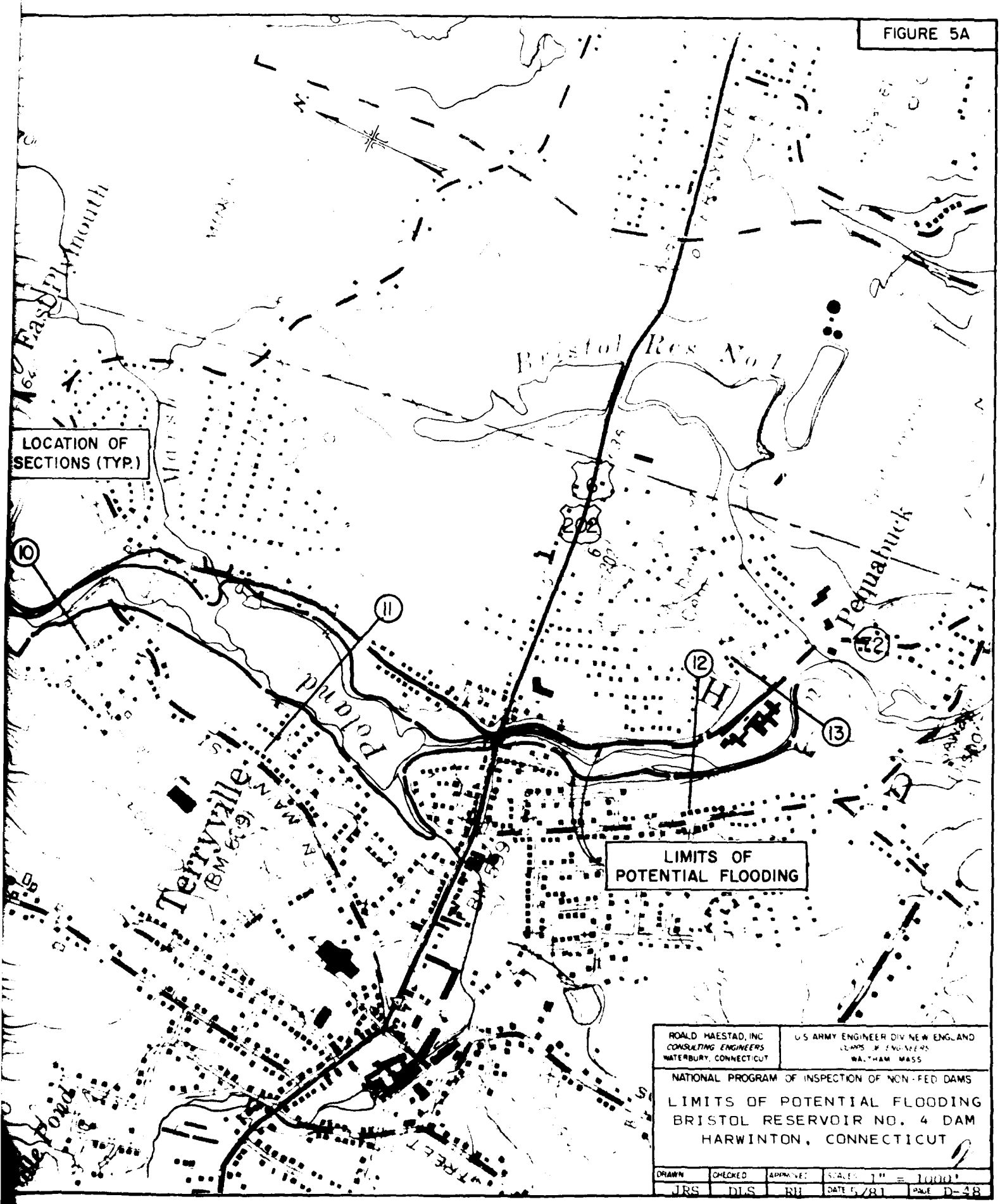

HARTFORD
6
7
8
9
10
12
LOCATION OF SECTIONS (TYP.)
BRISTOL RESERVOIR NO. 3
MATCH TO FIGURE 5
PRESTON ROAD
Pequabuck
River
Upper Pond

FIGURE 5A



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NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LIMITS OF POTENTIAL FLOODING
BRISTOL RESERVOIR NO. 4 DAM
HARWINTON, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALE	PAGE
JRS	DLS	RH	DATE 5/81	D-48

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME